Printed on Thin Paper for Foreign Circulation.

Engineering Library

SEP 22 1921

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXXXII.—No. 3427] LONDON: FRIDAY EVENING, SEPTEMBER 2, 1921 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Civil Engineer Required by the GOVERNMENT of HONG KONG for service as an ASSISTANT ENGINEER in the PUBLIC WORKS DEPARTMENT for three years, with prospect of permanency. Salary £400 per annum, rising by annual increments of £20 to £600 per annum. Free passages and rent allowance in accordance with Government Regulations.

Candidates must be unmarried, 24 to 28 years of age, and have passed the A.M. Inst. C.E. examination or obtained an equivalent university degree. They must be regularly trained civil engineers, good draughtsmen, well up in levelling, land surveying, and sounding, and have had experience in the design and construction of sewer and storm water drainage works.—Apply at once, in writing, giving age and brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/11,023. 6027

Logging Engineering ASSISTANT to the Timber Superintendent of the FEDERATED MALAY STATES GOVERNMENT RAILWAYS REQUIRED for 3 years' service in the first instance, with probable permanency. Salary 600 dols. per month, rising to 800 dols. a month by annual increments of 25 dols. a month, plus a strictly temporary and non-pensionable allowance of 15 per cent. of substantive salary for single men and 20 per cent. for married men. (The Government rate of exchange is now 2s. 4d. to the dollar, but the purchasing value of the dollar in Malaya is at present considerably less than that of 2s. 4d. in the United Kingdom.) Free passages, and, if married, for wife and children not exceeding four persons.

Candidates, not over 32 years of age and preferably single, who must be graduates of some recognised Forestry College and have had actual logging experience, with practical knowledge of saw-milling and logging estimates, be capable of draging up topographical maps suitable for logging purposes, and be prepared to work under conditions prevailing in a tropical country, assisted by native chainmen only, should apply in writing to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, giving brief details of age and experience and quoting M/F M S. 9440. 6024

The Proprietor of Letters Patent No. 28,753/1910, relating to VAPORISERS OF INTERNAL COMBUSTION ENGINES,

DESIRES to DISPOSE of his PATENT or to GRANT LICENCES to interested parties on reasonable terms with a view to the adequate working of the patent in this country.—Inquiries to be addressed to

CRUIKSHANK and FAIRWEATHER, 65-66, CHANCERY-LANE, LONDON, W.C. 2. 6015

The Proprietor of Letters Patent No. 20,741/1914, relating to DEVICES FOR PREVENTING THE ESCAPE OF OIL AND THE ENTRANCE OF WATER AROUND PROPELLER SHAFTS AND THE LIKE,

and No. 168,307, relating to STUFFING-BOXES FOR PROPELLER SHAFTS.

DESIRES to DISPOSE of his PATENTS or to GRANT LICENCES to interested parties on reasonable terms with a view to the adequate working of the patents in this country.

Inquiries to be addressed to

CRUIKSHANK and FAIRWEATHER, 65-66, CHANCERY-LANE, LONDON, W.C. 2. 6016

The South Indian Railway Company, Limited.

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of :—

1. COPPER PLATES FOR LOCOMOTIVE FIRE-BOXES.
2. VOLUTE AND HELICAL SPRINGS.
3. STEEL BOILER PLATES.
4. WHEELS AND AXLES.

Specifications and forms of Tender may be obtained at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Copper Plates," or as the case may be, must be left with the undersigned not later than 2 p.m. on Wednesday, the 14th September, 1921.

A charge, which will not be returned, will be made of 20/- for each copy of specification.

Copies of the drawings may be obtained at the office of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD, Managing Director.

91, Petty France, S.W. 1,
30th August, 1921. 6058

Tyne Improvement Commission.

TENDER FOR THE SUPPLY OF TWO CORNISH MULTITUBULAR BOILERS FOR THE NEWCASTLE SWING BRIDGE.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the SUPPLY and DELIVERY of TWO CORNISH MULTITUBULAR BOILERS for the Newcastle Swing Bridge.

Copies of the form of Tender, conditions of contract and specification may be obtained on application to the undersigned on payment of a deposit of £1, which will be returned on receipt of a bona fide Tender.

Tenders, in sealed envelopes, endorsed on cover "Tender for Boilers," must be addressed to the undersigned and delivered not later than Noon on Wednesday, September 14th, 1921.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
J. McD. MANSON,
General Manager and Secretary.

Tyne Improvement Commission Offices,
Bewick-street, Newcastle-upon-Tyne,
30th August, 1921. 6059

Wellington City Corporation, NEW ZEALAND.

The Wellington City Corporation invite TENDERS for the SUPPLY, DELIVERY, and ERECTION of the following :—

SECTION "A."—TWO WATER-TUBE BOILERS, with FEED-WATER HEATERS, SUPERHEATERS, STOKERS, &c.

SECTION "B."—ONE 5000 K.W. TURBO-ALTERNATOR, with CONDENSING PLANT.

Specifications and form of Tender may be obtained from Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W. 1, on payment of a deposit of £2, which will be refunded on receipt of a bona fide Tender.

Extra copies of the specifications may be obtained on payment of 10s. each, non-returnable.

Sealed Tenders, endorsed "Wellington Tender," to be delivered to Messrs. PREECE, CARDEW and RIDER, 8, Queen Anne's-gate, Westminster, S.W. 1, before 11 a.m. on Thursday, October 13th, 1921.

The Corporation do not undertake to accept the lowest or any Tender. 6053

The Engineer

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A Drop Hammer Battery for China.

Railways in British Malaya.

Crystal Palace School of PRACTICAL ENGINEERING. Founded 1872.

Principal : J. W. WILSON, M.I.C.E., M.I. Mech. E. The NEW COURSE will COMMENCE on WEDNESDAY, SEPTEMBER 14th. 6017

University of Bristol. ASSISTANT LECTURER in ENGINEERING, £300-£350.

For particulars and form of application send stamped, addressed, foolscap envelope to the REGISTRAR, Merchant Venturers' College. 5977

University of Glasgow. JAMES WATT CHAIRS IN THE DEPARTMENT OF ENGINEERING.

The University Court will, during the course of the University term beginning 1st October, 1921, proceed to the APPOINTMENT of a JAMES WATT PROFESSOR of ELECTRICAL ENGINEERING and a JAMES WATT PROFESSOR of the THEORY and PRACTICE of HEAT ENGINES.

Information regarding the Chairs may be obtained on application to the SECRETARY of the UNIVERSITY COURT, University of Glasgow. 5969

Aberdeen Waterworks. ASSISTANT ENGINEER WANTED IMMEDIATELY, with good experience in the Design and Construction of Large Water Mains, Reinforced Concrete, &c. Salary £250 per annum (subject to fluctuation in accordance with the cost of living).

Apply, with full chronological statement of experience, testimonials, state of health, age, &c.

GEORGE MITCHELL, M.I. Mech. E., 6049 Water Engineer.

SITUATIONS OPEN

WANTED, Thoroughly Experienced MECHANICAL ENGINEER for London Rubber Works, to Take Complete Charge of all Maintenance, Repairs and Erection of New Plant. Must have had good all-round electrical and mechanical experience. Salary £400 per annum.—Address, 6035, The Engineer Office. 6035 A

BOILER INSPECTOR.—WANTED by the Manchester Steam Users' Association, a PRACTICAL ENGINEER, age 25 to 35, conversant with the Construction of Boilers and Steam Plants, to fill the position of INSPECTOR. The duties will require him to examine boilers internally and also to go up the flues ; he must be capable of taking boiler dimensions, making sketches of boilers, and drawing up reports. Commencing salary £250 per annum.—Apply by letter, stating age, experience, and previous engagements, &c., to the SECRETARY, 9, Mount-street, Manchester. 6033 A

COMMERCIAL STRUCTURAL ENGINEER REQUIRED, to Take Charge of London Office of large Constructional Engineers manufacturing steel-framed buildings, roofing, circular work and bridge-work, &c. Must have had experience in this class of work and able to secure orders and take control of staff, preparing designs, estimates and tenders, and outside representatives. State age, experience, and salary required in strict confidence.—Address, 6054, The Engineer Office. 6054 A

COMPETENT ELECTRICAL ENGINEER REQUIRED for large E.H.T. Power Station in the East, to Take Charge (under superintendent) of entire Maintenance of Switchgear, Alternators, &c. Liberal salary and allowances. Three years' agreement. Single man preferred, age not over 35.—Address, 5990, The Engineer Office. 5990 A

ENERGETIC and Capable MAN, with Thorough knowledge of oxy-acetylene welding plant, as MANAGER of a Firm Manufacturing and Selling Welding Plants. A fair salary and a liberal share of profits to the right man.

Address, with full particulars of experience, age, and salary expected, P3958, The Engineer Office. P3958 A

SITUATIONS OPEN (continued)

ENGINEER ASSISTANT to MANAGER REQUIRED for London. Good prospects for smart man with selling experience and power station connection. Some drawing. Knowledge of air filters an advantage. Salary and commission.—Address full particulars, experience, age, salary required, P3943, The Engineer Office. P3943 A

MARINE ENGINEER REQUIRED for Smyrna, to Superintend a number of Small Ferry Steamers and Take Charge of Small Workshop.—Write, fully stating age, experience, and salary required, to E363, c/o Deacon's, 7, Leadenhall-street, London, E.C. 3. 6046 A

MESSRS. BERTRAMS, Limited, St. Katherine's Works, Sciennes, Edinburgh, REQUIRE the SERVICES of a thoroughly competent and energetic MAN to Supervise Workshop. Applicants must have held similar positions of responsibility and must have thorough knowledge of modern methods of economical production. Experience in Papermaking Machinery an advantage.—Apply by letter only, stating age and full experience, with copies of recent testimonials. 6028 A

MESSRS. BERTRAMS, Limited, St. Katherine's Works, Sciennes, Edinburgh, REQUIRE the SERVICES of a resident London REPRESENTATIVE. Applicants must have had practical experience of Papermaking Machinery, including Drawing-office experience.—Apply by letter only, stating age and full experience, with copies of recent testimonials. 6029 A

CHIEF DRAUGHTSMAN WANTED, Man of Proved ability in the Design of Small High-class Repetition Work (press and automatic). Permanent position offered to man possessing the highest qualifications, experience in the above class of work essential. Must be able to control staff of draughtsmen and get best results.—Apply by letter only, giving full particulars, to JOSEPH LUCAS, Ltd., Birmingham. 6048 A

WANTED, DRAUGHTSMAN, Used to Centrifugal Pump Details.—Address, 6047, The Engineer Office. 6047 A

CHIEF DRAUGHTSMAN WANTED, to Take Full Charge of Drawing-office, by firm of engineers dealing with heating, ventilating, and drying plants and general engineering. Must be used to handling men and be a strict disciplinarian. State full experience and salary required, with copies of not less than three recent testimonials, which will be treated in confidence.—Address, 6056, The Engineer Office. 6056 A

FURNACE DRAUGHTSMAN WANTED, Conversant with Steel and Ironworks and Foundry Requirements. Age, references, and experience.—Address, P3956, The Engineer Office. P3956 A

SENIOR DRAUGHTSMAN REQUIRED for Experimental Aircraft Design. Applicants must have had first-class technical training and previous experience in this class of work.—Apply, stating age, experience, salary required, and when can take up duties, to E., Employment Department, BOULTON and PAUL, Ltd., Norwich. 6013 A

FOREMAN MOULDER WANTED for the Loam Moulding Section of Large Ironfoundry. Applicants must have had first-class experience in this class of moulding, and only those who have held similar position elsewhere will be considered. The position is a permanency to a suitable man.—Apply, in writing, stating age, experience, and salary required, 6057, The Engineer Office. 6057 A

GENERAL FOREMAN MOULDER WANTED to Take Charge of Large Ironfoundry making castings up to 30 tons weight, comprising green and dry sand, loam moulding and core making. Applicants must have held similar positions of responsibility, be used to the successful control of men, and have good knowledge of up-to-date foundry practice, including piecework systems. Applications, which will be treated in confidence, should state age, experience (in full), approximate salary required, and be accompanied by copies of recent testimonials.—Address, 5986, The Engineer Office. 5986 A

SITUATIONS OPEN (continued)

FOREMAN MOULDER REQUIRED, to Take Control of Large Plate and Machine Moulding Shop o Ironfoundry. Applications are invited from men who have specialised on moulding machines and can prove their ability to turn out large quantities of repetition work on an economical basis. State age, experience, positions already held, and salary required.—Address, 5988, The Engineer Office. 5988 A

FOUNDRY FOREMAN, Working for Small Foundry near London ; must be well up in the production of High-class Castings, Water-jacketed Cylinders to stand high pressures and the like, and must be able to produce credentials ; no others need apply. State age, wages, &c.—Address, 6025, The Engineer Office. 6025 A

SHEET METAL WORKER REQUIRED, to Act as Charge Hand ; general experience and previous service as charge hand essential.—Box 133, Samson Clark and Co., Ltd., 56, Gt. Portland-street, W. 1. 6021 A

FIRST-CLASS POWER STATION FITTER for works power plant, Midlands. Must have had first-class experience with Water-tube Boilers, High-speed Engines, and Auxiliary Plant. Write, stating age, wages required, together with full details of apprenticeship and experience.—Address, 6039, The Engineer Office. 6039 A

LOCO. COST CLERK WANTED ; Must be Able to read and extract material from Loco. Drawings ; no others need apply. State age, experience, and salary required.—W. G. BAGNALL, Ltd., Stafford. 6031 A

REQUIRED, ESTIMATING CLERK for Engineering Works, turning out various repetition parts. Only those with the necessary experience to enable them to prepare reliable estimates and accustomed to modern methods need apply. Fullest particulars, in strictest confidence, and salary.—Address, P3898, The Engineer Office. P3898 A

SITUATIONS WANTED

A LEADING MECHANICAL DRAUGHTSMAN-DESIGNER DESIRES BERTH or PRIVATE WORK ; 25 years' experience, printing, general machinery, locomotive, inventions ; original worker ; excel. record.—H., 3, Rosemary-avenue, N. 3. P3948 B

APPOINTMENT REQUIRED by Engineer (25), Locomotive shops, apprenticeship including pattern-making and running department. Two years' experience as marine engine draughtsman, including costing and estimating. Sound technical education. Excellent references.—Address, P3955, The Engineer Office. P3955 B

ASSISTANT ENGINEER DESIRES POSITION ; good draughtsman, technical education ; experience steam, gas, and oil engines, surveying, &c.—H., 74, Weldon-crescent, Harrow. P3937 B

BUYER to Large Manufacturing Engineers DESIRES NEW APPOINTMENT. Extensive experience of markets ; manager and organiser of large dept. ; keen disciplinarian and administrator. Age 29 years. Highest references.—Address, P3918, The Engineer Office. P3918 B

BUYER to MANUFACTURING ENGINEERS Will be OPEN to ACCEPT NEW APPOINTMENT end of August. Has had very wide experience as manager of large department. Keen organiser and administrator.—Write, Z. Y. 292, c/o Deacon's, Leadenhall-street, London. 6041 B

CIVIL ENGINEER, B.Sc. (Eng.), London, Student C. Inst. C.E., ex-Service, aged 22, SEEKS APPOINTMENT at home or abroad as ASSISTANT. Capable surveyor (any instrument) and draughtsman.—Address, P3953, The Engineer Office. P3953 B

ENGINEER, A.M.I.M.E. (32), Abstainer, Well educated, DESIRES CHANGE. Present assistant manager in large works. Disciplinarian, proved organiser, latest methods of production, works layout, design, progress, estimating, costing, buying, correspondence, &c. ; wants position as Assistant to General Manager, Works Manager or Assistant with progressive firm, where ability will be recognised. Excellent references. Strictest confidence.—Address, P3930, The Engineer Office. P3930 B

ENGINEER, A.M.I. Mech. E., London, REQUIRES REPRESENTATIVE, AGENCY, or CONSULTING WORK. Sound experience in hydraulic, chemical, and oil installations, factory lay-out and general engineering.—Address, 6008, The Engineer Office. 6008 B

ENGINEER, Ex-Service, 8 Years R.N., 4½ Years submarine service, exp. turbo-generators, A.C. and D.C., refrigerators, air comp. ; 2nd Cl. B. of T. certificate ; age 32 ; REQUIRES JOB, home or abroad.—Address, P3941, The Engineer Office. P3941 B

ENGINEER-LIEUTENANT, Special Reserve, R.N., 1st Class B.O.T., public school man, 40 years of age, wishing to give up seafaring life, DESIRES a JOB in U.K.—Address, P3928, The Engineer Office. P3928 B

ENGINEER, M.I. Mech. E., DESIRES CHANGE ; electrical and mechanical training, accustomed to designing, estimating, lay-out, handling men, and repetition work. Responsible position as Factory or General Manager required.—Address, P3920, The Engineer Office. P3920 B

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ENGINEER (20), Live Man, Well Educated Speaks French, REQUIRES progressive POSITION, outside staff preferred; 7 years' mech. and elect. experience, works, D.O., and commercial, cranes, hoists, battery trucks and runways.—Address, P3927, The Engineer Office. P3927 B

ENGINEER (25, Single), 2 Years D.O. and 3 Years in shops of gen. mech. engineers, also 18 months crude oil engine building, well educated, slight know. French and Spanish, DESIRES POSITION of TRUST as ASSISTANT; London or 60-mile radius preferred, or abroad. Good refs.—Address, P3935, The Engineer Office. P3935 B

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Three years R.N.S.P. Co.; considerable experience hydraulic and refrigerating machinery; extra-chief engineer's B.O.T. Certificate, London; four years Rand; large experience turbo-generators, stamp batteries, cyanide plants, air compressors, electric motors all sizes and types, multi-stage centrifugal pumps, steam and electric hoists, transformers, &c., &c., resident engineers' Certificate for Union of South Africa; four years constructing and maintaining Beyrus steam shovels, locomotives, blowing engines, washing plants and concentrators of all sizes, water turbines, Babcock and Wilcox, Stirling, Smulders, Humboldt and Marshall boilers, fitting, boiler, machine and moulding shops in Katanga.

WAR SERVICE.—1914: Temp. Eng.-Lieut. R.N., H.M.S. New Zealand, Battle-cruiser, 1915: Staff Captain-Superintendent Clyde district; large experience constructing warship machinery. 1916: Chief Engineer, H.M.S. Nupia. 1917: Promoted Eng.-Lieut.-Commander R.N.; Chief Engineer, H.M.S. Contest. 1918: Commanding Officer, Royal Naval Experimental Section, Admiralty.

At present mechanical and electrical engineer large group of mines, Katanga, Africa. Knowledge French; good draughtsman, excellent disciplinarian with foreign labour; superior London and African references; Scotch; non-smoker, temperate, robust constitution, hustler, age 35, married; £60 to £100 per month expected.

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ENGINEERING WORKS MANAGER. Full experience all branches engineering, including electrical, planning, lay-out reconstruction, organisation and overhead efficiency.

Full particulars past results on application.—Address, 5823, The Engineer Office. 5823 B

FOUNDRY MANAGER, Brass, Iron, &c., Would LIKE to HEAR from FIRMS that REQUIRE the SERVICES of a FIRST-CLASS MAN; green sand, dry sand, loam and machine moulding. Good organiser and controller of men.—Address, P3829, The Engineer Office. P3829 B

MECHANICAL ENGINEER, A.M.I. Ae. E., Age 31, 16 years works, D.O., administrative, DESIRES POSITION as Assist. Works Manager, Dept. Manager, or similar post, at home or abroad. Varied experience, general, I.C.E., and small parts production. Patentee. Progressive position more important than high salary.—Address, P3936, The Engineer Office. P3936 B

MECHANICAL ENGINEER (25), Good Technical education, G.I. Mech. E., A.M.I. Mech. E. Exam., 7 years' practical experience, I.C. engines, machine shop, fitting shop, testing, &c., DESIRES POST, experimental work preferred. Prospects primary consideration.—Address, P3940, The Engineer Office. P3940 B

MECHANICAL ENGINEER (46), Ten Years in present position with largest coal and coke company in United States, would LIKE to LOCATE in England. Exceptionally good experience and highest references. State salary offered to save time.—Address, P3934, The Engineer Office. P3934 B

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REPRESENTATIVE. — RAILWAY ENGINEER, public school, A.M.I. Mech. E., 7 years' experience Mech. Dept., G.N.R., also on mech. work in M.E., single, 31, REQUIRES POSITION with commercial firm.—Address, P3930, The Engineer Office. P3930 B

TO CONTRACTORS, &c.—ENGINEER and AGENT REQUIRES an APPOINTMENT; 14 years' experience in charge river and waterworks, shipways, electric power-houses, reinforced concrete, steel-framed structures, and office buildings; also good experience designing.—Address, P3914, The Engineer Office. P3914 B

TO CONTRACTORS AND OTHERS.—CAPTAIN, late Royal Engineers, with extensive pre-war and post-war experience in charge of works, and has carried out several well-known jobs, including nine years' London experience, REQUIRES APPOINTMENT as Manager, Engineer, or Agent with a well-established company.—Address, P3915, The Engineer Office. P3915 B

YOUNG ENGINEER (22), Mech. Eng. Diploma, some experience, WANTED, POSITION (anything giving exp.); smart, quick, reliable. Write for qualifications.—R. BISHOP, 77, Sisters-avenue, Clapham, S.W. 11. P3945 B

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ENGINEERING DRAUGHTSMAN (32), with 17 years' shops and D.O. experience, REQUIRES PERMANENT POSITION; well up in general and contractors' machinery, refrigeration, waterworks plant and mechanical filtration.—Address, P3954, The Engineer Office. P3954 B

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SITUATIONS WANTED (continued)

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FOREMAN MOULDER AT LIBERTY. Good organiser; spec. in plate and machine moulding, millwright, agricultural, or general engineering work. Good refs.—Address, P3957, The Engineer Office. P3957 B

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INST. C.E., Inst. Mech. E., B.Sc., and all ENGINEERING EXAMINATIONS.—Mr. G. P. KNOWLES, M.I.E.E., B.Sc., A.M. Inst. C.E., &c., personally PREPARES CANDIDATES, either orally or by correspondence. Hundreds of successes during the past twelve years. Courses can be commenced at any time.—29, Victoria-street, Westminster, S.W. Telephone No. Victoria 4780. Ex

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For continuation of For Sale Advertisements, see page iv.

AUGUST.

The Airship Disaster.

AT ten minutes past seven on the morning of Tuesday, the 23rd, the airship R 38—or Z R 2, to give her the American designation—under the command of Flight-Lieutenant A. H. Wann, R.A.F., and carrying a mixed crew of British and American officers and men, left Howden airship base for her fourth trial. A certain portion of the pre-arranged programme was carried out apparently satisfactorily, but it was decided, in order to complete the necessary trials, to remain out all night and finish the work on the following day. Cruising between Howden and Pulham, the trials were continued on Wednesday until 5 p.m. At 4.30 p.m. she was carrying out a full-speed trial, and soon after intimated by wireless that it was proposed to land at Howden at 6.30 p.m. At a quarter to six she was flying over Hull engaged apparently in making rudder tests at high speed. She was suddenly seen to emit a cloud of smoke, to buckle or break in the middle, and to fall, enveloped in flames and exploding, into the Humber close to the Corporation pier. Of the forty-nine officers, civilians, and men on board, only five—among whom was the captain, Lieutenant Wann—escaped with their lives. Details of this airship were published in our issue of June 10th following upon a personal inspection of her which we made when she was being prepared at the Royal Airship Works, Cardington, for her first trial. That trial was carried out on a flight of 6½ hours, during the night of June 23rd–24th. The control system was found to require alteration, and after the necessary modifications had been effected a second trial of about six hours' duration was carried out on the night of June 28th–29th. Further alterations, the nature of which has not been revealed, were then found to be necessary. The third flight was begun on the evening of July 17th, and lasted about nine hours, a speed of 50 knots being attained without calling upon the full engine power. Some of the amidship girders during this trial were found to have been weakened before the airship landed. These girders were reinforced at Howden, the work being completed by July 30th. Bad flying weather then supervened, with the result that the fourth trial could not be attempted until last week. These are all the facts at present officially available to guide us in seeking an explanation of the cause of the disaster, but from unofficial information it is possible that it resulted from the failure of one of the main members of the framework following upon an attempt to make a sharp turn at a high speed. An Air Ministry court of inquiry is at present investigating the matter behind closed doors, but it seems doubtful whether the real cause will ever be definitely ascertained in view of the completeness of the wreck of the structural parts of the airship.

Tidal Power.

AN event of importance during the past month was the presentation to the Hydraulic Section of the French Ministry of Public Works of a scheme for laying down an experimental tidal power installation at Aber Vrac'h, near Brest. At a time when the coal famine obliged the French Government to investigate the various sources of energy a good deal of attention was given to the utilisation of power produced by the flux and reflux of tides. Sums of money were voted to assist in the carrying out of approved schemes, of which the most promising appeared to be the Aber Vrac'h, and the final plans have been accepted by the Ministry of Public Works, which is carrying out the usual public inquiry before granting the concession. This concession is sought by a group which will receive financial aid from the Government, while additional funds will be raised by an issue of debentures. Although modestly described as an experimental station, it will be equipped nevertheless with four turbines and alternators, each giving, under a maximum head, 1200 horse-power, and the current will be distributed for lighting and power purposes at Brest, about 25 kiloms. distant. To prevent interruption at high and low tides, a dam will be constructed across a neighbouring river to hold up water for running a generating plant. French hydraulic engineers appear to have faith in the success of the installation, which they believe will be followed by other similar plants along the Channel and Atlantic coasts.

The Railways Act, 1921.

THE first day of the month saw the House of Commons, although it was Bank Holiday, considering the Railways Bill on Report, a stage which also occupied the 2nd, 8th and 9th. On the last-named day the third reading was carried by 237 to 62, the voting being on the rejection of the Bill, moved by Sir Frederick Banbury, who, although the deputy chairman of the Railway Companies' Association, had throughout opposed the Bill. For this reason the companies' mouthpiece had been Major Hills, a director of the Midland Railway, whose handling of the companies' amendments, combined with an unexpectedly sweet reasonableness on the part of Sir Eric Geddes and the loyalty of Mr. J. H. Thomas to the men's bargain with the companies, made the passage of the Bill remarkably smooth. It was read a first time in the House of Lords on the 10th, a second time on the 11th, the Committee stage occupied the 16th and 17th, and on the 18th it was read a third time. The following day—Friday, the 19th—the Lords' amendments were accepted by the Commons, and the Bill received the Royal Assent that evening. The control or "possession" of the railways, that came into being at the outbreak of war, was, under Sec. 3 of the Ministry of Transport Act, 1919, to remain in force for a period of two years after the passing of that Act. It was generally assumed that, as the Royal Assent was given on August 15th, 1919, that this period expired on the 14th, but as the railway companies maintained that it lasted until the midnight of the 15th—in which event their receipts were guaranteed for another day—the Ministry of Transport conceded the point, and control ceased on the night of the 15th.

Birkenhead's New Water Supply.

IN the middle of the month the ceremony of turning on the water supply from the Alwen reservoir was performed in Hamilton-square, Birkenhead. It is more than twenty years ago since, on the advice of the late Dr. G. F. Deacon, M. Inst. C.E., Birkenhead decided to go to Wales for additional supplies of water. The necessary Act to give effect to the advice was obtained in 1907, and that the scheme has been so long coming to completion must, in large measure, be attributed to the war. As a fact, the dam which impounds the waters of the Alwen to the extent of upwards of 3000 million gallons, was built in very quick time, and was practically finished five years or so ago. The length of the aqueduct from the dam to the Cross Hill reservoir above the town is about 42 miles. It consists for the most part of cast iron pipes varying in diameter from 36in. to 19in., but there are four short tunnels, the most noteworthy of which is that under the river Dee, which was driven by shield and is lined with cast iron rings as are the tube railways. Quite a feature of the undertaking is the Cross Hill service reservoir, which is claimed to be the cheapest covered reservoir for its size which has ever been built. It contains about 30 million gallons, and is of such area that each foot of depth in it represents a million gallons. Much of the gathering ground which drains into the Alwen reservoir is covered with peat, which has the effect of imparting a considerable stain to the water. It was therefore decided to treat the latter with lime and to pass it through mechanical filters before sending it down the pipe line. The treatment is, we understand, an entire success. The top water level in the Alwen is 1190ft., and that of the Cross Hill service reservoir 233ft., both above Ordnance Datum. On the aqueduct there are two break-pressure tanks, one at an elevation of 995.5ft. and the other at 521ft. It is possible to by-pass the service reservoir so that if at any time it should become necessary, a pressure due to over 500ft. head of water can be made available in Birkenhead. The amount of water which can be obtained daily from the new source is estimated at 7,200,000 gallons.

The Irish Railways.

ALL the concessions made to British railwaymen in January, 1920—the eight-hour day, payment for Sunday duty and overtime, holidays, &c.—applied equally to the men employed on the Irish lines, and thus the grievances about which the Scottish companies complained were accentuated in Ireland. In view of the cessation of control on the 15th, the Irish companies gave the men a week's notice of considerable reduction in wages. Just prior to this the Government had agreed with the Irish companies to pay them three millions in settlement of their claims for arrears of maintenance and renewals, and the necessary parliamentary financial resolution was about to be passed when the Labour Party opposed it unless the companies agreed to have a National Wages Board as on the British railways. All the thirty-two companies, except the Great Northern, were willing to agree, and, in the end, an Arbitration Board was set up and began its inquiry, under the presidency of Mr. William Carrigan, K.C., on the 22nd. The terms of reference are: (*a*) Whether the principle of standardisation should be adopted in the settlement of wages and/or conditions of service on the Irish railways; (*b*) whether a universal eight hours' working day should be maintained on the Irish railways. The proceedings are in public, and are expected to last a fortnight. Meanwhile, until the question of the retention of the eight hours' day is decided, the existing rates of pay remain in force. From what has appeared in the Belfast newspapers it would seem that the Great Northern—which is not represented on the tribunal—is not reducing its pay, but is generally restoring the ten hours' day. The men on that line threatened to come out on strike at midnight on the 29th, but this action was averted by the company agreeing not to put into operation the increased working hours until after the award of the arbitration tribunal.

Trade Impediments.

THE passing of the Anti-Dumping Bill has proved a severe blow to the extreme protectionist policy adopted in France. The desire of the French to reserve everything for home industries was first shown in the rejection of the British and American offers to carry out reconstruction work in the devastated regions when the country would have benefited undoubtedly from a rapid resumption of activity in those areas. In the same way, it was decided to replace treaties of commerce, which for more than forty years had kept France in bondage to Germany, with a system of commercial arrangements whereby a separate agreement would be made with each country, and to prepare the way for those agreements, the fiscal tariffs were put up 300 per cent. above the pre-war duties, the idea being that they would permit of advantages being offered to other countries in return for similar concessions in favour of French goods. As, however, the tariffs were graduated to limit the facilities to raw and partly manufactured materials and to manufactured goods that do not compete directly with home industries, the negotiations for commercial arrangements with Belgium and Switzerland fell through. Thus the protectionist policy from which so much was expected failed utterly. Its extinction seems inevitable in view of the Anti-Dumping Bill, which has placed France in a state of economic isolation. There is not much in the situation that can lead to the hope of an early recovery. It was even openly asserted during the month that there can be no permanent trade improvement without an economic alliance with Germany. The real solution of the difficulty, however, lies in a return to a more liberal commercial system which can alone give prosperity to the manufacturing industries; but for the moment the French Government seems to feel itself morally bound to do everything possible for the protection of new industries which it was largely responsible for creating after the Armistice.

Yarrows.

SLOWLY, indeed, yet with increasing speed, the false economics which prevailed during and after the war are being worn away by the weight of facts. Working people are beginning to see that capital is readily exhaustible, that the State purse is not bottomless, that orders will not come in if prices are too high, and that in asking for too much they lose all. But the hard lesson has to be driven home, and the action taken by Yarrows in the middle of the month must be regarded as of national importance. The firm announced with regret that owing to the high cost of shipbuilding, the incessant annoyance of strikes against the employers, and the interference with work caused by demarcation disputes between trades unions, it would close the Scotstoun yard in November, keeping open only the experimental and research departments. Everyone who knows Sir Alfred Yarrow will appreciate the pain such a decision must have given him. No employer in the country has more earnestly endeavoured to keep on the kindliest terms with his workpeople, and the thought of turning them adrift must be bitter to him. But he sees that the good of the shipbuilding industry, the good of the country demands that the true economic position should be made plain to the shipyard workers, and he has taken the only course that was possible when methods of persuasion had failed. It is impossible to think of any firm more suitable for the administration of this lesson in practical economics than Yarrows. We hope sincerely that it may succeed so well that the fulfilment of the announcement may be found unnecessary when November comes, and that the whole shipbuilding industries will be restored to a sounder basis.

American Ordnance Production in the Great War.

No. II.*

At the beginning of the war anti-submarine tactics were in their infancy. It is true that various forms of sweeping gear, including explosive sweeps, had previously been experimented with by the British Navy, but an imperfect realisation of the submarine's powers of mischief hampered the active development of measures for coping with it. Even so, it is remarkable that no one foresaw the necessity of depth charges, or, if it was foreseen, that nothing was done, either here or abroad, to produce a weapon of such extraordinary value for attacking hostile submarines. There appears to be no doubt whatever that the credit for manufacturing the first effective depth charge belongs to the British Admiralty. The new weapon first came into use in 1915, but the number available was so limited that only a few destroyers could be supplied with it, and these had strict orders to use their precious depth charges only when the occasion seemed to promise certain success. The shortage continued throughout 1916, but thereafter the output increased very rapidly, and before the end of 1917 depth charges were being carried by nearly every type of vessel engaged in anti-submarine operations. The first American depth charge was designed in February, 1917, that is, two months before the United States entered the war; but it contained only 50 lb. of explosive, which experience soon showed to be inadequate, and a few months later a new model was designed, containing a charge of 300 lb., which corresponded to that of the British type. The American and British types differ in several important respects. The former is detonated by means of hydrostatic pressure, whereas the British utilises the seepage principle also; in the American type the mechanism is installed inside the container to reduce the likelihood of its receiving damage in handling or service, while the British firing gear protrudes several inches beyond the head of the cylindrical case. The American firing mechanism retains the safety chamber principle, which ensures that, should the detonator be fired by accident, the charge would not be detonated. Finally, the character of the explosives differ, the British using amatol and the Americans the more powerful T.N.T. Three marks of 300 lb. depth charges were manufactured in the United States during the war, the last mark having a depth setting up to 300ft. To meet the demand for an exceptionally powerful charge in certain cases, a 600 lb. mark was produced. A total of 72,000 American depth charges were contracted for during the war, but a large number of these had not been delivered at the signature of the Armistice.

Impressed with the possibilities of the Thornycroft depth charge thrower, the Bureau of Ordnance conceived the idea of applying the Davis gun—non-recoil—principle to this device, and eventually designed the Y-gun, so called because of its twin barrels set respectively at an angle of 45 deg. from the vertical. At each discharge this gun throws two 300 lb. depth charges in opposite directions, the range—varying from 50 to 80 yards—being regulated by the size of the impulse charge. Vessels armed with Y-guns are able to lay down a wide barrage against submarines, a form of tactics which proved most effective. By the end of the war, 947 Y-guns of American manufacture were in service.

We come now to the inception and execution of the "Northern Barrage" plan, which stands out as a monumental achievement in an international conflict remarkable for enterprises conducted on a scale of magnitude far beyond anticipation. The idea of laying a barricade of mines across the northern outlet from the North Sea must have occurred to many who had studied the submarine problem, but the difficulties it involved were so formidable that the British Admiralty did not feel justified in giving effect to the scheme, though they were fully alive to its advantages. When the United States joined the Allies the plan was revived, and thanks mainly to the representations of American officers, it was formally approved in October, 1917. As originally projected, the mine barrier was to extend between Aberdeen and Ekersund, Norway, but before any mines had been laid the location was changed to a line running between the Orkney Islands to Bergen. "This change," we learn, "was really made so that the mind of the Commander-in-Chief of the Grand Fleet would be free from worry as to mines, in that he could operate anywhere in the North Sea from Scapa southward without passing through the barrier, as would not have been the case had the original line, Aberdeen to Ekersund, been adopted."† As no mine then in existence answered to the requirements postulated by the peculiar conditions set up by this barrage, the first task of the Bureau of Ordnance was to design a mine specially adapted to the purpose. Some of these requirements were:—Quick-loading mine cases; anchors suitable for use in water deeper than any hitherto contemplated and of much greater reliability and ruggedness; a system of assembling anchor and mine that permitted their being planted as a unit, accurately and at high speeds; a firing device widening the danger zone of each mine, &c. It was clear that unless an extravagant number of mines were to be used a type must be developed which would explode not only when struck by a submarine, but also when a submarine passed near at hand. The disadvantage of a sensitive firing device was its supposed liability to be made active by handling, the action of waves, or the explosion of an adjacent mine. This risk was eliminated by patient experiment, and the mine—Mark VI.—embodying the device was finally adopted as the standard type for the Northern Barrage. Its adoption reduced the number of mines required for the barrage by two-thirds. The total weight of the United States Mark VI. mine is 1400 lb., of which the explosive charge of T.N.T. weighs 300 lb. The mine was designed in such a way that modifications of any one feature could be made without detriment to the others. To facilitate this the elements of the mine were divided into groups, each representing a separate design problem, and all parts so standardised that the several groups would assemble into a complete mine. Satisfactory results attended this system, and when the first completed mines were tested they were found to operate as designed. By no other system than that of dividing the mine into many parts and distributing their manufacture among many firms would it have been possible to reach the high rate of production called for by the emergency. When the Northern Barrage was projected there was but a single plant—the Norfolk Navy Yard—which had had experience in manufacturing the complete article, and, apart from its pre-occupation with other pressing naval work, the resources of that yard would have been utterly incapable of producing the large number of mines that were needed. The Bureau of Ordnance aimed at obtaining delivery of 1000 mines per day. A further advantage accruing from the system of distributing component parts was that complete secrecy as to the character of the mine itself could be preserved, for, as the Bureau points out, "it is obvious that if 100 different parts of a mine are manufactured by as many different factories, most of which are kept in ignorance of the fact that they are producing mine material, no one will have sufficient information to visualise the complete mine, and, therefore, no one can possibly betray the secret to the enemy."

The Mark VI. mine case was made up of two hemispheres of steel which were welded together at the equator. A central tube extending along the axis of the case contains the firing mechanism. An interesting feature of the design is the omission of a separate chamber in the mine case for holding the explosive. This chamber had the drawback of additional weight, of complicating manufacture, filling and assembly, and, most serious of all, of interposing an air cushion between the first explosive shock and the water, thus considerably reducing the force of the impact caused by the detonation of the mine. The separate chamber was dispensed with by selecting an explosive which could be readily cast and cooled, and by casting this directly into the completed mine case, where it was kept in place by the four stay braces supporting the central tube. Moreover, this method of construction kept down the dimensions of the mine case, which was only 34in. in diameter. The explosive chosen—T.N.T.—has many advantages for the purposes, not the least being its impermeability to water. A mine so charged remains as "live" as ever after being submerged for years. Safety in handling was another desideratum aimed at in the design. This was fully attained, for 85,000 Mark VI. mines were shipped to Europe, and 56,611 of them were laid in the barrage, all without misadventure. Careful attention was given to ensure that a premature explosion could not take place until a safe interval had elapsed after launching the mine. This was guaranteed by a hydrostatic device which kept the detonator away from the main explosive until after the mine had entered the water and reached a depth of 30ft. As the need for haste left little time for experiment, the British automatic anchor—"Mark VIII. sinker"—was adopted, such modifications as were necessary being carried out under the direction of Lieut.-Commander H. Isherwood, R.N.V.R., an experienced mine officer, who was attached to the United States Bureau of Ordnance by courtesy of the British Admiralty. This anchor, as modified, is a generally rectangular box of steel plate, 2¼ft. square by 2ft. high, weighing approximately 816 lb. It contains the mooring cable, wound on a drum; while a plummet, containing the plummet cord, is hooked on one end. Practically all the contracts for the mine itself were placed after competitive bidding. In all there were 140 principal contractors and over 400 sub-contractors. Before ordering the 100,000 mine anchors needed the Bureau called a conference at which the representatives of forty-two companies were present. The anchor consists of 100 different parts, exclusive of bolts, nuts, washers, and rivets, and the materials involved are sheet steel, stamped and pressed, forged steel, cast iron, bronze, brass, and wood. "The assembly of all these parts, on a quantity basis, presented a difficult problem. Motor car makers, of which a number were represented at the conference, are specialists in assembly, as this is one of their chief problems in obtaining quantity production; and it was apparent that they were best fitted for the major contracts, which would include the assembly of all the parts. It is believed that the Bureau of Ordnance was the first of the war agencies to take advantage of the wonderful resources of the automobile industry." Contracts for manufacturing the anchor were placed with three automobile firms in Detroit, and those for various small parts and attachments distributed throughout the country. Over 50,000,000ft. of wire rope for mooring cables and plummet cords, and 20,000 tons of steel plate, rolled by six large mills, were used in the execution of this work.

Meanwhile the Bureau had to create a plant capable of loading the mines, ready for shipment abroad, at the rate of 1000 a day. This was established at St. Julien's Creek, Va. Here there was storage space for 5000 empty mines, a melting plant capable of melting and pouring T.N.T. for at least 1000 mines a day; a cooling building, where the charged mines were allowed to cool off before shipment; a T.N.T. storage depôt with a capacity of 4,000,000 lb.; a heating plant, and a wharf. Conveyors and labour-saving devices entered largely into the scheme of organisation, which was planned with the dual object of rapid operation and safety. More than 73,000 mines, involving the melting and handling of more than 22,000,000 lb. of T.N.T., were loaded without accident at this plant, which, in addition, received and shipped abroad a further 17,000 mines which had been loaded elsewhere by contract. The mines, when filled, were conveyed to Europe by a fleet of twenty-three cargo steamers, with an average capacity of 3000 tons deadweight, each cargo consisting of about 1500 complete units. Larger vessels could, of course, have taken more mines at each shipment, but it was considered desirable to limit the number that would be lost in the event of a mine carrier being sunk. The ships were remarkably fortunate, only one falling a victim to German submarine attack. For the inspection and assembly of mines destined for the Northern Barrage two advanced bases were established in Scotland, one at Invergordon and the other at Inverness. The buildings were furnished by the British Admiralty, but in all other respects were under American naval control, the *personnel* numbering 814. The work of assembly, which began soon after the first mine carriers arrived at the bases in April, 1918, was a highly organised process. Before assembly the various components were inspected separately, after which the mine case and the anchor were conveyed on tramways to a point where they were joined together and the unit was finally tested. The mines thus completed were transferred to the store sheds or directly to the mine-laying vessels. Careful organisation produced wonders, the mines were assembled and tested with a rapidity never before attained, and the estimated rate of output at the two bases, viz., 500 a day, was easily increased to 1340. Owing to this increase in production and the unexpected speed with which the mines were laid in the barrage, the rate of shipment of mines had to be accelerated from 3500 a week to 6000.

The American mine-laying flotilla had originally consisted of two vessels only, the San Francisco and Baltimore, with a combined capacity of only 350 mines. It was necessary, therefore, to create a new squadron for the purpose, and a call went out for ships which were to be of ample size, easy to manœuvre at sea, sound in boilers and machinery, with good cargo-handling equipment, so arranged internally as to permit the fitting of mine tramways on two or three decks, a speed of 14 to 20 knots, and generally seaworthy. Eventually such vessels were secured. They included four steamers of the Morgan Line, with a sea speed of 14.5 knots and a capacity of 800 to 850 mines, renamed Roanoke, Housatonic, Canandaigua, and Canonicus; two fast coasting steamers, renamed Shawmut and Aroostook, with a speed of 20 knots and a capacity of 300 mines; and two Old Dominion steamers, renamed Quinnebaug and Saranac, speed 16.5 to 17 knots, capacity 600 mines each. Rear-Admiral J. Strauss, commanding the mine force, hoisted his flag in the repair ship Black Hawk. The squadron thus assembled sailed from the United States on May 11th, 1918, arriving at the bases in Scotland on May 26th.

The laying of the Northern Barrage was a joint British and American enterprise, the original plan and most of the material and facilities having been prepared by the United States Bureau of Ordnance. The actual laying of the barrage began on June 8th, 1918, when the American squadron went out and laid 47 miles of the new Mark VI. mines. An authentic report came in shortly afterwards that a German submarine, cruising on the surface, had been badly damaged by one of these mines. Thirteen excursions in all were made by the American squadron, the last being carried out on October 26th, 1918. As early as July 29th, however, a complete line of mines had been placed in the sea area allotted to the United States naval forces, subsequent mines thickening and reinforcing this barrier, which, in the words of the Bureau of Ordnance, "should be likened to a very rough, treacherous stretch of country, whose crossing would be a desperate venture, rather than to a country protected by a single barrier, such as the Great Wall of China, requiring one great effort to cross." Of the total of 70,263 mines laid in the Northern Barrage, 56,611 were of the American type and laid by the American squadron. It was customary for each

* No. I. appeared August 19th.

† Navy Ordnance Activities, World War, 1917–18. Washington: Government Printing Office.

laying expedition to be made by ten American and four British mine-layers, the squadron being convoyed as a rule by British destroyers. On one of these excursions a total of 6820 mines was dropped in four hours—5520 by the Americans and 1300 by the British. On another day the American squadron laid a field 73 miles long. The best single ship record was that of the U.S.S. Canonicus, which laid 830 mines in 3½ hours. The Barrage area embraced three zones, known as A, B and C—A being the centre of the line, B the end towards the Orkneys, and C that towards Norway. Area A was mined exclusively by the Americans, who laid in addition 10,400 mines in area B and 5980 mines in area C. The system of laying was common to all areas :—(1) a line dangerous to surface craft and to submarines at periscope depth ; (2) a line dangerous to submarines submerged from 90ft. to 160ft. ; and (3) a line dangerous to submarines at 160ft. to 240ft., the latter being the estimated maximum depth at which submarines could navigate.

As completed, the Barrage extended from Udsire Light, at the fringe of Norwegian territorial waters, to a point within 10 miles of the Orkney Islands, this ten-mile passage being continuously and strongly patrolled. The total distance was 230 miles, and the greatest depth of water 1100ft. Since the width of the barrage varied from 15 to 35 miles, a submarine traversing it was in danger from one to three hours when running on the surface, and twice that time when travelling submerged. As the barrage grew the Germans sought to avoid it by using Norwegian territorial waters on their way to the open sea, but even this gap was eventually sealed by the decision of the Norwegian Government to protect the sanctity of its waters by minefields. As regards the efficacy of the barrage as a check on the German submarines, the Bureau of Ordnance writes : "It is interesting to note the statement of a captured German submarine commander, who expressed the opinion that, of all the anti-submarine measures taken, mines were by far the most dreaded by the submarine *personnel*, principally because there was nothing to indicate their presence. On account of the great improvement in mines, he said, the former practice of fishing up mines, for conversion into punch bowls, had been entirely abandoned !" The exact number of enemy submarines destroyed, damaged, or hampered in their operations by the Northern Barrage can never be known exactly. It is, however, certain that six submarines were destroyed and an equal number severely damaged. "It is considered probable, by the British Admiralty, that the loss of five other submarines, the cause for which cannot be definitely proven, is accounted for by this Northern Barrage. In so far as reliable records are obtainable, then, a total of seventeen submarines is the toll taken by this mine barrage. . . ." There is, besides, evidence that the barrage was a potent factor among those which contributed to the lowering of *morale* in the German submarine service and the consequent falling off in its efficiency. Had the war continued the utility of the barrage might have been demonstrated in a more striking fashion. Even as it was, the results as a whole more than compensated for the labour and expenditure which had been devoted to the undertaking. The extension of American mining operations to the Mediterranean was contemplated in the autumn of 1918, beginning with the laying of a new barrage across the Strait of Otranto. This would have been 54 miles long and contained 8000 mines. It was further proposed to lay a second trans-Adriatic barrage, probably from Brindisi to Saseno Island, consisting of 22,800 mines ; and to put down a barrier of 26,800 mines in the Ægean Sea from Euboea Island to Cape Kanapitza. All these mines were to be provided and laid by the American forces. Their effect would have been, first, to prevent access to the Mediterranean of submarines working from Austrian ports ; and, secondly, to prevent the entrance to the Mediterranean of submarines coming from Turkish ports. It was anticipated that these barrages would practically put an end to U-boat depredations in the Mediterranean, but the conclusion of an armistice with Turkey on October 30th, 1918, and with Austria, four days later, rendered it unnecessary to proceed with the undertakings in question.

Water Power Resources of Canada.

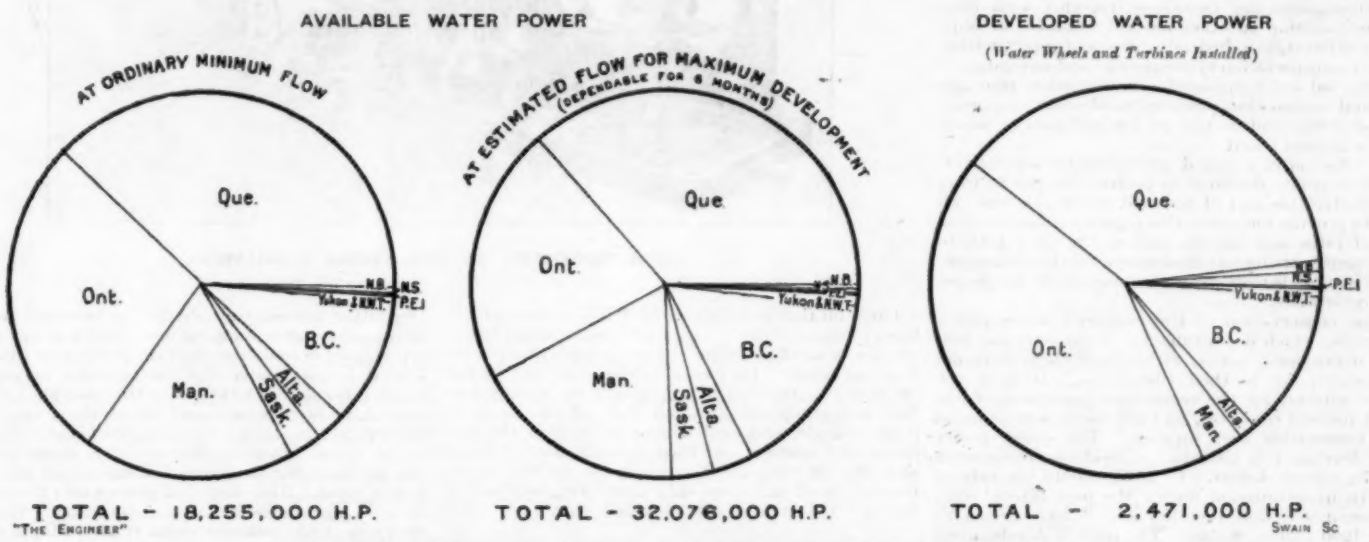
DURING the past two years there has been carried out by the Dominion Water Power Branch of the Canadian Department of the Interior a careful re-analysis and computation of Canada's water power resources. All existing stream flow and power data, available from Dominion and provincial sources, have been systematically collated, analysed and co-ordinated with a view to preparing, on a uniform basis from coast to coast, revised estimates of the power available. While the analysis is not yet finally completed, sufficient progress has, the Department considers, been made to warrant the publication of the figures given herein. It has accordingly issued a Note, which we reproduce practically verbatim in what follows. In the Note the total available and developed power resources are presented in a manner not heretofore adopted. A consideration of the figures will indicate that they place the water power resources of the Dominion in a much more favourable light than have previously published compilations. While the resources have been exhaustively analysed in so far as the information forthcoming will permit, it should be kept in mind that only very meagre data are available in many districts and for many rivers.

The figures given in the accompanying table and diagrams are based upon rapids, falls and power sites of which the actual existent drop or the head possible of concentration is definitely known or at least well established. Innumerable rapids and falls of greater or lesser power capacity are scattered on rivers and streams from coast to coast which are not as yet recorded, and which will only become available for tabulation as more detailed survey work is undertaken and completed. This is particularly true in the more unexplored northern districts. Nor is any consideration given to the power concentrations, which are feasible on rivers and streams of gradual gradient in places where economic heads may be created by the construction of power dams, excepting only at such points as definite studies have been carried out and the results made matters of record. In brief, the figures given are based on definite rapids, falls and power sites, and may be said to represent the minimum water power possibilities of the Dominion.

The power estimates have been calculated on the basis of twenty-four-hour power at 80 per cent. efficiency on the basis of "ordinary minimum flow" and "estimated flow for maximum development." The "ordinary minimum flow" is based on the averages of the minimum flow for the lowest two consecutive seven-day periods in each year, over the period for which records are available. The "estimated flow for maximum development" is based upon the continuous power indicated by the flow of the stream for six months in the year. The actual method of determining this flow has been to arrange the months of each year according to the day of the lowest flow in each. The lowest of the six high months is taken as the basic month. The average flow of the lowest seven consecutive days in that month determines the maximum for that year. The average of such maximum figures for all years in the period for which data are available is the estimated maximum used in the calculation. This estimated maximum development has been based upon the assumption that it is good commercial practice to develop turbine installations up to an amount, the continuance of which can be assured during six months of the year, on the assumption that the deficiency in power during the remainder of the year can be profitably provided from storage or by the installation of fuel power plants as auxiliaries. The correctness or otherwise of this assumption for any particular site can only be definitely settled by the careful consideration of all circumstances and conditions pertinent to its development. The method, however, has, it is claimed, enabled a fairly satisfactory over-all estimate of the maximum hydraulic power available, as distinctive from the estimated ordinary minimum power available, to be made.

The recorded power available throughout the Dominion of Canada, under conditions of ordinary minimum flow and within the limitations set out in the foregoing, is 18,255,000 horse-power. The water power available under estimated flow for maximum development, i.e., dependable for at least six months of the year, is 32,076,000 horse-power. There are installed throughout the Dominion water wheels and turbines to the extent of 2,471,000 horse-power. However, it would not be correct to place that figure in direct comparison with the minimum or maximum available power figures quoted above, and therefrom to deduce the percentage of the available water power resources developed to date. An allowance must be made for the average ratio between the water wheels installed and the power available. An analysis of the water power plants scattered from coast to coast, concerning which complete information is available as to turbine installation and satisfactory information as to stream flow, gives an average machine installation 30 per cent. greater than the six-month flow maximum power. On that basis, the figures quoted above therefore indicate that the at present recorded water power resources of the Dominion will permit of a turbine installation of 41,700,000 horse-power. In other words, the present turbine installation represents only 5.9 per cent. of the present recorded water power resources.

In spite of the outstanding facts that financial and commercial conditions are still far from normal and that costs of construction are almost prohibitive for all but absolutely necessary undertakings, there has been during the past year, and is now, marked activity in hydro power construction. This has resulted from a variety of causes, principal among which is the lack of native coal in the central industrial district and the fortunate position of economic water power sites with respect to industrial centres. The total hydro power development installed during the past year or now under construction represents approxi-



DIAGRAMS ILLUSTRATING THE AMOUNTS OF AVAILABLE AND DEVELOPED WATER POWERS

Available and Developed Water Power in Canada.

Province.	Available 24-hr. power at 80 per cent. efficiency.		Turbine installation. H.P.
	At ordinary min. flow, H.P.	At est. flow for max. dev. (dependable) for 6 mos.), H.P.	
1	2	3	4
British Columbia	1,931,142	5,103,460	304,535
Alberta	475,281	1,137,505	32,492
Saskatchewan	513,481	1,087,750	—
Manitoba	3,270,491	5,769,444	83,447
Ontario	4,950,300	6,808,190	1,052,048
Quebec	6,915,244	11,640,052	925,972
New Brunswick	50,406	120,807	21,180
Nova Scotia	20,751	128,264	35,774
Prince Edward Island ..	3,000	5,270	1,933
Yukon and North-West Territories	125,220	275,250	13,199
	18,255,316	32,075,998	2,470,580

mately 560,000 horse-power of installed capacity. That figure includes only the initial installations of plants under construction, not their ultimate designed capacity. It is evidence of the manner in which the water power resources of the Dominion are being put to effective and productive use.

It is profitable, the Note continues, to consider the history of water power utilisation in Canada during the past few years in conjunction with the present activity with a view to making some reasonable forecast as to its probable future growth. Should the rate of water wheel installation during the past fifteen years be maintained, there will be installed in 1925, 3,360,000 horse-power; in 1930, 4,110,000; in 1935, 4,860,000; and in 1940, 5,600,000 horse-power. In view of the increasing appreciation of the advantages of hydro power combined with the fortunate situation of ample supplies within easy transmission distance of practically every great industrial centre throughout the Dominion, there is every reason to anticipate that the rate of growth in utilisation will be accelerated rather than retarded. Reference to the foregoing totals of water power available will indicate that this anticipated increase in utilisation will not seriously reduce the total reserves. Canada possesses sufficient reserves of water power to meet all anticipated demands for many years to come.

In order to ensure the most beneficial utilisation of those reserves and to provide intelligent guidance for their development, two essentials are, it is insisted, required:—

> First, an accurate knowledge of the situation, capacity and of the engineering and economic possibilities of development of the water powers throughout the Dominion, together with their relationship to other natural resources of mine and forest, to industrial centres and opportunities, to transportation systems—rail and navigation—to coal and fuel supplies, to irrigation, drainage and reclamation projects, to alternative sources of power and to market for and uses of power in general; and
>
> Secondly, a sound governmental administrative policy designed to protect the public from inadvisable and ill-designed power schemes and to provide for reasonable regulation and revision of rates and rentals, and at the same time to ensure satisfactory guarantees for the encouragement of legitimate investment in hydro power enterprises.

True conservation of the country's water power resources, which are inexhaustible through use, lies, it is maintained, not in withholding them from development, but in their efficient utilisation in the public interest for the economic exploitation of our other natural resources, and for the conservation of our exhaustible fuel supplies. The water power now developed in Canada represents an investment of 475 million dollars. In 1940, should the rate of growth in installation during the past fifteen years be continued, that investment will have grown to over 1000 million dollars. The present development represents an annual equivalent of 18½ million tons of coal, which, valued at 8 dollars per ton, represents 148 million dollars. In the year 1940 these annual figures will, with the foregoing assumption, have become 42 million tons and 336 million dollars. These figures are striking evidence of the outstanding importance and necessity of an intelligent administrative policy governing the development of the water power resources of the Dominion.

Developments in Power Station Design.

No. VII.*

DURING the coal strike eight of the boilers at the Lots-road power station were equipped with Thornycroft oil fuel burners. Other boilers in the station were fitted with Scarab burners, as described in the last article. John I. Thornycroft and Co. were, of course, among the pioneers in the development of apparatus for burning oil fuel, and the company's system was first applied to the motor lifeboat Queen, built in 1892. Subsequently the system was adopted in the Navy, and for many years past the high-speed torpedo boats constructed at the Southampton works have been fitted with the Thornycroft oil fuel apparatus. An equipment for handling from 900–1000 lb. of oil per hour is shown in Fig. 24, whilst Fig. 25 shows an alternative duplex equipment with two tanks, which can be worked jointly or singly, so as either to give a combined burning capacity of from 18,000 lb. to 20,000 lb. per hour or to provide a reserve or stand-by supply of fuel. When these equipments are in service the oil, heated to the required temperature, is sprayed under pressure into the boiler furnaces. The proper admixture of air and fuel necessary for combustion is provided by the burners, which operate on the mechanical pressure system without the use of compressed air or steam. The standard Thornycroft burner is one in which both edges of the tangential exit holes are tangential to the whirling chamber, an arrangement which has been found to atomise the oil very efficiently.

Standard burners are designed for maximum outputs of 200 lb., 300 lb., 400 lb., 500 lb., 700 lb., and 1000 lb. of oil per hour, but as the sprayers are adjustable, intermediate outputs can be obtained. The oil is drawn through pipes and coarse strainers by means of pumps, which force it through the filters and heaters and into the burners fitted to the boilers.

* No. VI. appeared August 26th.

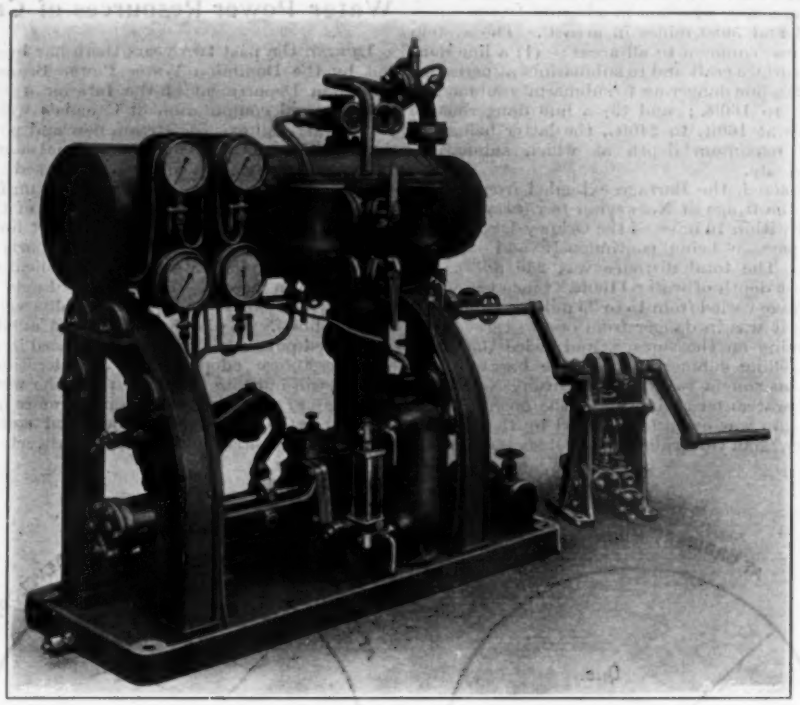


FIG. 24—THORNYCROFT OIL FUEL PUMPING INSTALLATION

Large oil fuel installations have two or three-throw hand pumps, which are used whilst lighting up; but in the case of small plants hand gear is simply fitted to the main oil pump. By means of the main pumps the oil is drawn through a piping system, arranged so that any pump can draw oil from all the tanks or from a single tank and deliver it through the first filters and heaters and then through second filters and the distributing box sprayers on the boiler fronts. Small units are only fitted with one pair of filters. The pumps are provided with air vessels

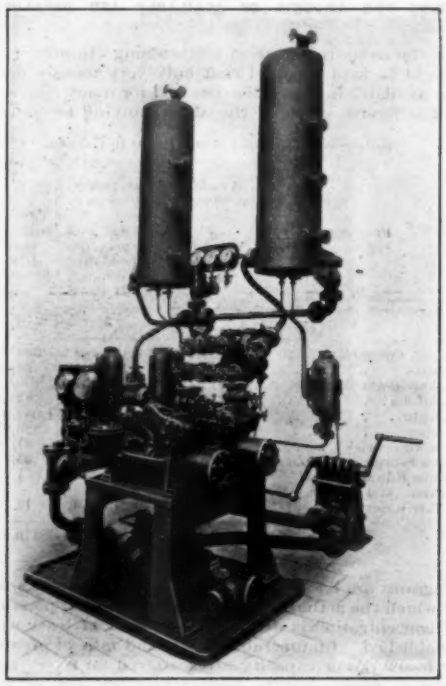


FIG. 25—DUPLEX PUMPING UNIT

which are sufficiently large to ensure a continuous flow of oil without pulsations, and to give constant pressure on the delivery side of the pump an adjustable spring-loaded relief valve is fitted, from which the surplus oil is led back to the suction side of the pumps and the valve is graduated to work at 25 lb., 50 lb., 75 lb., 100 lb., 125 lb., and 150 lb. pressure. When starting up the main pumps care has to be taken to ensure a steady pressure, and special valves are provided to assist in that direction. The filters contain double layers of steel gauze and they can easily be opened for cleaning, and any filter can be cleaned without in any way altering the output of the oil or interfering with the working of the plant. The heaters are composed of cast iron or wrought steel bodies, which contain seamless steel tubes through which the oil passes and which raise the temperature to 120 deg. or 200 deg. Fah., according to the nature of the oil. The latter temperature should be regarded as the limit, as at higher temperatures trouble is apt to be experienced in consequence of the presence of a carbon deposit in the heater and the presence of vapour, which is liable to interfere with the spraying. In the case of the large equipments two or three drains are fitted on the heater for the purpose of controlling the temperature. Drain collectors with gauge glasses are provided for detecting leakage of oil past the heater tubes. Risk of the oil getting into the boilers and causing trouble is therefore eliminated. Water is drawn from the collector about twice during a watch for the purpose of observation. Preferably the water is drawn off into a china bowl, as the presence of oil can then easily be detected. Thermometers are employed for showing the temperature of the oil before it enters the furnace, and there are gauges to show the pressures at the burners, &c. The difference in pressure at the inlet and outlet of the filters indicates whether the filters are choked up, and consequently whether or not they require cleaning. Distribution boxes containing master valves for each sprayer are fitted on the boiler fronts.

The oil pressure depends upon the amount of oil that has to be burnt; but, generally speaking, when the burners are working at their full output the pressure does not exceed 150 lb. per square inch. When varying the rate of steaming the supply of oil should as a rule be varied by reducing or increasing the oil pressure, and sprayers are shut off or opened when this does not give the desired working range. The oil temperature depends upon the kind of oil used, and it should be high enough to make the oil sufficiently fluid to enable it to be sprayed. If the temperature is too high pulsation may occur and particles of deposited carbon are apt to interfere with the working of the sprayers. If violent pulsations occur they can as a rule be stopped by reducing the temperature of the oil. The air supply depends, of course, on the amount of fuel burnt, and when a boiler is under way the air should be regulated so that a faint stream of smoke is seen at the top of the chimney. Economy largely depends on the air supply, and the makers of this system consider that although natural draught can be adopted in connection with burning oil fuel, it is better to work with draught obtained by means of fans. The main oil tanks are fitted with vent pipes to carry off vapour, &c., and to allow air to take the place of the oil that has been withdrawn. Arrangements are also made to enable graduated sounding rods to be inserted into the tanks for the purpose of ascertaining the amount of oil which the tanks contain.

The White low-pressure system which is supplied by the White Patent Oil Burning Company, Ld., of South Shields, and has been put into use in the Dunston power station, is another system which works with mechanical atomisation. Heated oil is forced under a moderate pressure through a specially designed burner, which

so pulverises the oil that it issues from the burner tip in the form of a hollow cone-shaped mist completely surrounded by air within and without, and atomising agencies such as steam or compressed air are not required. With the oil in this condition it is, of course, only necessary to bring into intimate contact with it the proper amount of oxygen of the air in order to secure complete combustion; but it is of vital importance, the makers of the White burner point out, that the contact be sufficiently intimate to secure a perfect admixture of oil and air and also that the supply be uniform, continuous, and under proper control. In the White system these conditions are claimed to be so well met by means of a patented air heating device, and a simple arrangement of air regulating cones which govern the supply of air and the spread of the flame, that the latter commences 1in. from the burner tip and its length does not exceed 3ft. Combustion

FIG. 26—WHITE BURNERS FITTED TO BABCOCK BOILERS

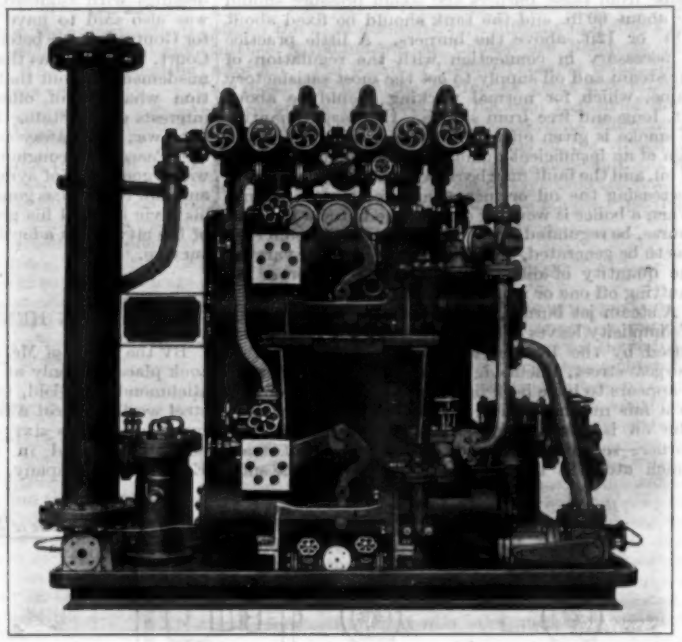


FIG. 27—WHITE DUPLEX PUMPING UNIT

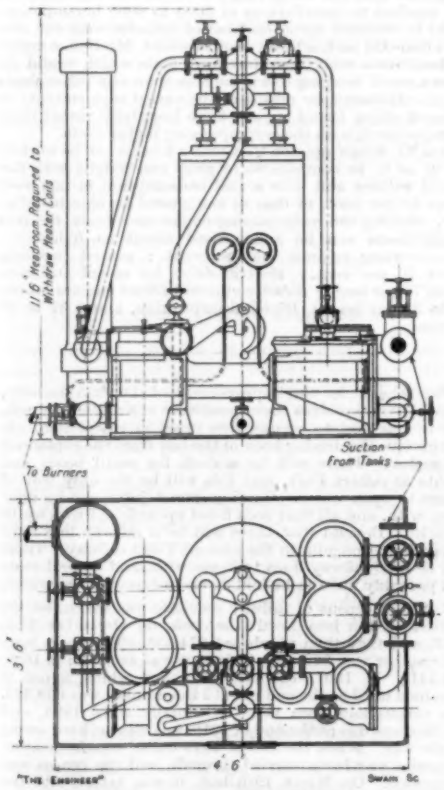


FIG. 28—WHITE SIMPLEX PUMPING UNIT

at the front end of the furnace is ensured and only the clear hot gases of combustion pass up through the tubes and impart heat to them.

The conversion of a boiler from coal to oil fuel burning presents little, if any, difficulty. In the case of a furnace worked with forced draught, such as Howden's, the Howden front is left undisturbed and the White castings are bolted on to the inside. The casing forming the bottom half of the burner has a movable door, which gives access to the furnace. White burners are made in sizes ranging from 40 to 400 boiler horse-power, and one burner suffices for a furnace. The system is suitable for any kind of oil, and especially heavy Mexican fuel oils having a high calorific value and low cost. An evaporation of over 16 lb. of water from and at 212 deg. Fah. is regularly obtained with a pound of oil.

The burner, which is of very simple construction, atomises the heated oil, which impinges with an undiminished velocity upon a cone, and it issues through a nozzle or tip as a divided spray at the low pressure of 60 lb. per square inch. This pressure may, however, be reduced to 10 lb. per square inch and the spray will still be sufficiently fine to ignite. Owing to the absence of a compressed air or steam jet the burners are practically noiseless. The flame, which rarely exceeds 3ft. in length, is cone-shaped, and it fills the front end of the furnace. It is a clear incandescent white, shading to red at the periphery, with a faint trace of violet at the extreme edge.

With a view to securing good efficiency and to eliminating smoke the air supplied for combustion is raised to a high temperature. A cone-shaped casting, having radial heating vanes and an outer casing, is fitted over the mouth of the furnace, and the vanes form passages through which all air entering the furnace must pass. The front casting becomes heated and the radial vanes cause this heat to be imparted to the air which passes into the furnace at a temperature of about 220 deg. Fah. The burner itself is surrounded by a jacket tube, and by means of a sliding cone the position and spread of the flame can be governed at will. There is also another arrangement of air regulating cones which control the admission of air to a nicety, thus ensuring an intimate and thorough admixture of air and oil and, in consequence, complete combustion. The entire casing is secured to the front of the furnace and carries the burner and air regulating cones on a hinged spider which allows free access to the furnace when necessary. Some White burners fitted to Babcock boilers in a large power station are shown in Fig. 26.

The demand for complete and compact pumping equipments has led the makers to develop the duplex and simplex units shown in Figs. 27 and 28 respectively. These equipments, like those previously described, are complete in every detail and are made in sizes ranging from 200 to 6000 horse-power. The units comprise suction strainers, heaters, pumps, discharge strainers, relief valves, pump governor valves, thermometers, oil pressure gauges, and all other necessary valves and fittings, so that when the sets are delivered at the power station or other place where the oil fuel is about to be used it is only necessary to connect up the suction pipe to the oil service tank and the pipe from the discharge strainers to the burners. It will, of course, be understood that in the case of the unit shown in Fig. 27 the whole installation is in duplicate, and any pump, heater, or strainer can be overhauled without interfering with the operation of the system.

The Babcock steam jet burner, briefly mentioned last week, is shown in Fig. 29, and the method of starting up and working this burner may be of interest. If the oil is thick it is, of course, necessary to heat it by means of a steam coil until it is sufficiently liquid to flow freely through the pipes and burner. The temperature of the oil is usually kept at about 120 deg. or 170 deg. Fah., and in order to avoid any foreign matter getting into the burners the oil is, as usual, passed through a strainer before entering the pipes. It is then allowed to pass into the main oil pipe A and the steam into the main steam pipes B, the valves C and D and the cock E all being closed ready to commence working the burner. The burner nozzle is pointed into the furnace with the air registers open. The cock E, which is used for cleaning, must be closed and the oil valve C is opened so as to see whether the oil flows freely through the nozzle of the burner and, if so, the valve is immediately closed. The steam valve D is then opened so as to allow steam to pass into the burner, when the steam should emerge from the nozzle equally all round the centre tube of the burner, the jet being regulated at will by the hand wheel F. When the steam jet from the burner is satisfactory the boiler damper is opened and a torch, which is usually composed of a piece of oiled waste or asbestos fibre on

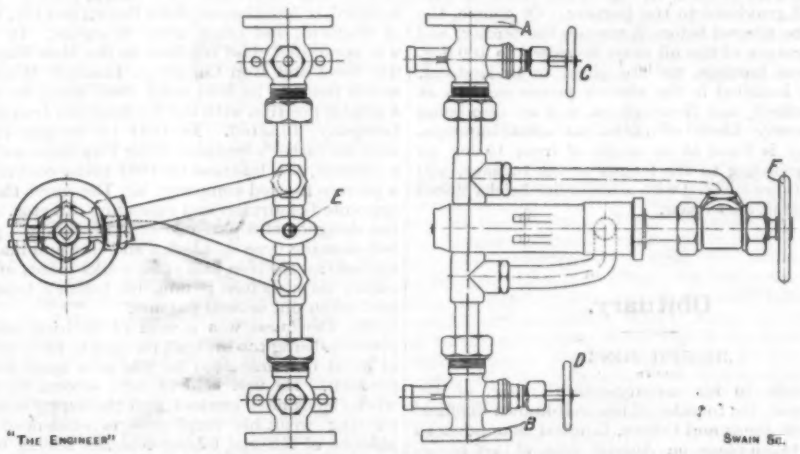


FIG 29—BABCOCK STEAM JET BURNER

a 4ft. rod, is held in readiness. With the steam jet still working the valve C is opened and at the same time the lighted torch is applied to the burner. It occasionally takes some little while, if the brickwork is cold, to get the burners alight, and it is therefore necessary for the first few minutes to watch the burners carefully in case one goes out, in which case it is generally necessary to re-light it with a torch.

When the furnace brickwork is thoroughly hot the burners light easily without a torch, but it is always advisable to have one handy. To obtain a satisfactory flame from these burners the steam pressure should be about 60 lb. and the tank should be fixed about 10ft. or 12ft. above the burners. A little practice is necessary in connection with the regulation of the steam and oil supply to get the most satisfactory flame, which for normal working should be about 6ft. long and free from smoke. If a large quantity of smoke is given off in the furnace it is generally a sign of an insufficient quantity of air for the quantity of oil, and the fault may be remedied, either by slightly decreasing the oil or increasing the steam pressure. When a boiler is working on load the burners must, of course, be regulated to suit the quantity of steam that has to be generated, and this may be done by varying the quantity of oil supplied to each burner or by shutting off one or more of the burners as required.

A steam jet burner, which from the point of view of simplicity leaves little to be desired has been introduced by the Lawton Machine Tool Company, of Burgess-street, Sheffield, and during the coal strike it appears to have been fitted to the boilers belonging to a fair number of manufacturers in that locality. The oil is passed by gravity from the tank to the burner—see Fig. 30—where it meets a jet of steam which atomises the oil and at the same time sufficient air is drawn in to produce combustion. The only part that fits in the furnace is a pipe, which goes through a hole in front of the furnace just above the doors, and a tank of any suitable shape and of the desired capacity is fixed on top of the boiler so that the oil will gravitate to the burners. Of course, the oil has to be filtered before it reaches the burner, and the temperature of the oil must be raised to 100 deg. Fah. These burners, we are given to understand, have been installed in the electric power stations at Leeds, Sheffield, and Nottingham, and are also being used in many kinds of industrial establishments. The burner is fixed at an angle of from 15 deg. to 25 deg., according to the length of the furnace, and the fire-bars are covered with ashes or fire-bricks placed so as to permit air to pass.

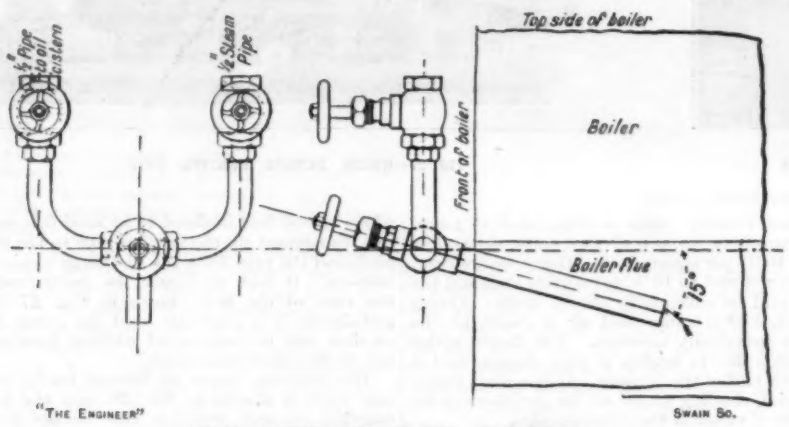


FIG. 30—LAWTON MACHINE TOOL CO.'S BURNER

Obituary.

JOSEPH JONAS.

THE death, in his seventy-seventh year, of Mr. Joseph Jonas, the founder of the well-known Sheffield steel firm of Jonas and Colver, Limited, is announced as having taken place on August 25th at his home, Endcliffe House, Sheffield. Mr. Jonas was a very remarkable figure. He was born at Bingen-on-the-Rhine in 1845, served his apprenticeship with an iron firm at Cologne, was afterwards employed for a short time at a Westphalian iron and steel works, and arrived in Sheffield, a stranger, in 1867, when he was twenty-one years of age. His first position was that of a commercial traveller, but within three years he had set up in business for himself. Two years later—in 1872—he was joined by the late Mr. Robert Colver, and under this partnership the business grew rapidly, eventually absorbed the firms of Colver Brothers and W. T. Beesley and Co., and in 1892 was floated as a private limited liability undertaking. To-day the continental works and Novo Steel Works of the company are amongst the largest factories for the manufacture of crucible cast steel, high-speed steel and various implements.

For very many years Mr. Jonas had a seat on the Town Council, and in 1905 filled the office of Lord Mayor of Sheffield. In that year King Edward and Queen Alexandra opened the Sheffield University building on Western Bank, and it was on that occasion that Mr. Jonas received the honour of knighthood—a distinction which was withdrawn during the war, in consequence of an incident which led to proceedings against Sir Joseph under the Defence of the Realm Act. Paul von Goutard, a Berlin munition maker, desired certain information about Vickers' new rifle works at Crayford, and Sir Joseph, who for many years prior to the war had had ordinary business dealings with Goutard, answered his inquiries, and was also said to have obtained certain information for Goutard a year before the war. The decision of the Court, however, was that Sir Joseph had committed a misdemeanour, but that he was guiltless of any intention whatever of offending against the safety or interests of the State. Shortly afterwards his knighthood was taken away and he ceased to be a Justice of the Peace. Throughout the affair, however, there was a good deal of sympathy locally with Mr. Jonas, and now that he has gone his sterling business qualities, his civic life and his great activities in the interests of the city of his adoption are the memories that will survive.

JOHN HENRY DEWHURST.

BY the death of Mr. John Henry Dewhurst, which took place suddenly at his home, "Beechy Knowle," Richmond, Sheffield, on August 22nd, the iron and steel world has lost a prominent member. Mr. Dewhurst was in his sixty-sixth year, and he had been actively engaged in the business of Dewhurst's Engineering Company, Limited, of Sheffield, of which he was chairman and managing director, up to the Saturday before his death. He was born at Manchester in 1854, and received his early education at Milk-street School, Sheffield. Later he obtained engineering experience with Sharp, Stewart and Co., Limited, of Manchester, John Brown and Co., Limited, of Sheffield, and other firms of repute. In 1886 he was appointed chief engineer to the Moss Bay Hematite Steel and Iron Company, Limited, Workington, which position he held until 1889, when he accepted a similar position with the Frodingham Iron and Steel Company, Limited. In 1891 he became identified with his father's business, John Dewhurst and Son, as a partner, the business in 1902 being converted into a private limited company, Mr. Dewhurst then being appointed chairman and managing director. He was the designer and patentee of "Dewhurst" patented self-cleaning type slag ladles and cars and many other specialities for iron and steel works plant, and in his earlier days, before joining his father's business, he had taken out several patents.

Mr. Dewhurst was a man of untiring energy, no problem being too difficult for him to face, and whilst of great determination he was of a most genial disposition. He was held in high esteem by all with whom he came in contact, and the happy relationship existing with his employees is evidenced by the absence of internal labour troubles during his chairmanship. He was a member of the Institution of Mechanical Engineers and of the Iron and Steel Institute.

PETER COOPER HEWITT.

THE death took place on Thursday, August 25th, at the American Hospital, Neuilly, in Paris, of Mr. Peter Cooper Hewitt. Mr. Hewitt, who was in his sixty-first year, was perhaps best known in Europe in connection with his work on the mercury vapour lamp and rectifier for converting alternating current into direct current, but he was also responsible for various other inventions associated with wireless telegraphy and telephony and electric welding. In 1903 the degree of Honorary Doctor of Science was conferred upon him by the Columbia University in recognition of his work. Throughout his life he devoted himself to the study of economics, physics, electricity and chemistry. He was at the head of mining, railway and philanthropic societies, and was associated with various organisations for the encouragement of art. He was also a member of the American Geographical Society, the Society of Naval Architects and Marine Engineers, Inventors' Guild, the National Institute of Social Sciences, and various American clubs.

Diesel-Electric Drive for Merchant Vessels.

A COMBINATION of Diesel engines and electric motors for the propulsion of merchant ships has been suggested recently in a paper read before the United States Western Society of Engineers, by Mr. Wilfrid Sykes. He pointed out that the difficulties of building Diesel engines increase very greatly with cylinder dimensions, and that the weight per horse-power also increases with the size of cylinders. These conditions led to the idea of using relatively small high-speed Diesel engines to drive generators supplying current to motors connected to the propeller shafts. The efficiency of engines developing 75 horse-power per cylinder is practically the same as that of engines of the largest capacity, according to Mr. Sykes, and that being the case there will be no loss on account of smallness of size. On the other hand, there would be the loss of electric transmission amounting to, say, about 12 per cent. But that would be partially overcome by the fact that slow speed propellers could be used running, in the case of a tramp steamer, at, say, 80 or 90 revolutions compared with a speed of, say, 120 revolutions customary with direct-connected Diesel engines.

The problem of running a number of Diesel engines together is difficult from the standpoint of alternating-current transmission, but it may, Mr. Sykes explains, be simplified by the use of continuous current. Generators can run in series feeding into one motor, or they can be grouped, series and parallel, and by proper regulation can be easily balanced up so that slight variations in speed of the engines do not affect the supply of current. With a scheme of this kind there is the greatest possible flexibility. For instance, take the case of four engines and one motor. If 150-volt generators are used, there will be 600 volts on the propelling motor, a voltage which can be safely used under conditions at sea. Of course, higher voltage could be used, although Mr. Sykes believes it wise to be conservative in that respect in the beginning. The failure of one generator or one engine would simply mean that it would be cut out of service and the voltage would be correspondingly reduced, but by manipulating the field of the motor, the proper speed could be obtained to use the three-quarter capacity available.

To obtain an intermediate speed for manœuvring, it is only necessary to regulate the field of the generators. With a scheme of this kind something can be done which has not heretofore been done with Diesel engines. As a moderate-sized cylinder is used, the engine can be simplified, as piston-cooling can be avoided. Engines of four, six or eight cylinders could be built up, and it is suggested that the whole range of requirements, say, from the smallest to installations of 5000 to 6000 horse-power, could be covered, using one size of cylinder with one size of valve. On such a basis, engines could, Mr. Sykes urges, be built on a truly manufacturing scale which would do more toward bringing down the cost than any other single factor. Hitherto, by reason of the varied requirements of different ships, Diesel engines have been built rather than manufactured, with the accompanying higher costs.

It is Mr. Sykes' opinion that such a scheme can be worked out so as to be comparable in price and weight with the geared turbine and with a fuel consumption of not over about 50 per cent. of that of the geared turbine installation. Taking the reciprocating engine as a basis, the fuel requirements can be summarised about as follows:—Reciprocating engines, 100 per cent.; geared turbines, about 70 per cent.; electric drive for steam turbines, about 75 per cent.; direct-connected Diesel engines, about 33 to 35 per cent.; Diesel-electric drive, about 37 to 40 per cent.

THE scheme for the improvement of Durban harbour, South Africa, involves the expenditure of a million pounds, and is expected to occupy five years in completion. It will involve the driving back of the bay from the esplanade altogether. There will be a dock for small boats and yachts at Albert Park, and this will be the only way of access to open water. Gardiner-street jetty will be done away with, and all that area filled up with soil to a width of 600ft. Beyond that there will be a railway line right across from Congella to the present Point railway. There will be four railway lines to begin with, and several more will probably have to be laid down to carry all the traffic.

THE first census of railway servants was taken, on the motion of the late Lord Aberdeen, on December 31st, 1873, and they then numbered 274,535. Ten years later the number was 346,426; in 1895 it was 465,112; in 1898, 534,141; in 1907, 621,341, at about which figure it remained until at the end of 1913 the number was 639,323. The census had been taken triennially since 1895, and another was due at the end of 1916, but was omitted owing to the war. When the end of 1919 came, standardisation of grades was being carried through, and the census was postponed. On March 19th last, it was taken, and the results have just been made known in White Paper Cmd. 1494, "Railway Companies (Staff)." The number was given as 766,381, which shows an increase of 19·4 per cent. over 1913, due undoubtedly to the introduction of a general eight-hours' day. The staff—3022—employed by the Railway Clearing House is now included. On the British railways there are 37,400 drivers, 35,888 firemen, 18,095 goods guards, 9072 passenger guards, 68,222 permanent way men, 23,561 goods porters, 32,812 passenger porters, 19,081 shunters, 30,736 signalmen, and 7948 stationmasters. The London and North-Western employs 101,483, the Great Western 91,985, the Midland 81,731, the North-Eastern 65,048, and the Lancashire and Yorkshire 45,388.

A Seven-Day Journal.

Trade Union Crisis.

IT has been apparent for some time past that trade unions were on their trial. The quarterly report of the General Federation indicates the nature of the serious problems which have had to be solved since the end of the war. The return to normal industrial and commercial conditions has been accompanied by unemployment of a more widespread character than any similar form of industrial disturbance within the recollection or even, it is asserted, the historical cognisance of the people of Britain. In one of the basic trades—the steel trade—no fewer than 90 per cent. of the members have been unemployed, and this and allied trades are likely to continue to suffer so long as the price of coal remains as high or even higher than the price of finished imported steel. The transport trades have been badly hit. The result has been a serious financial crisis for trade unions. A further problem is that of unstable membership due to the many additions made during the war period. The leaders of the Federation are now beginning to recognise that if trade unionism is to persist, it must have a better understanding of its relation to trade and commerce, and repudiate anything like a "ninepence for fourpence" policy in its financial arrangements.

Severn Barrage Scheme.

THE attempt to bring pressure to bear on the Ministry of Transport to authorise the Severn barrage scheme has failed. In a reply to the Newport Development Association, which has just been issued by the Ministry, it is stated that while it is possible the scheme may be proceeded with at a later date, when financial conditions are more favourable, nothing can be done at the present time. It has been decided even to refrain from appointing the technical commission of inquiry suggested by the Water Power Resources Committee. The Ministry of Transport will confine its activities in connection with the large scale Severn hydro-electric scheme to the collection of information which may be of use at a later date. The scheme was, it will be recalled, bound up with the construction of a Severn railway and road bridge, which would be of great importance in improving transport facilities with South Wales.

Shipbuilding Wages.

IN accordance with a previous arrangement, it has been decided to hold a conference in London on December 21st next to discuss the discontinuance to shipbuilding workers of the Ministry of Munitions bonuses. These bonuses would in ordinary circumstances have ceased to be paid after the end of last month, when the war in the official sense came to an end. It was, however, represented to the Shipbuilding Employers' Federation by the unions that the question of discontinuing the 12½ per cent. bonus to time workers and 7½ per cent. bonus to piece workers ought not to take place without discussion, and to this the Federation has agreed.

Engineering Trades Depression.

THE financial results of engineering companies recently announced reflect the depressed condition of the engineering industry. The dividend of the Bolckow, Vaughan Company has fallen from 12 to 8 per cent., while the directors of Crossley Brothers have withheld the payment of an interim dividend on the ordinary capital, although paying the preference interest as usual. In the case of Petters Limited, the operations of the last financial year—which have already received some publicity by reason of the attitude taken up by the labour element—have resulted in a loss, whereas for the preceding financial year a dividend of 10 per cent. was paid. The Vulcan Motor and Engineering Company reports a loss of £447,000 as the result of fifteen months' trading. Other cases might be quoted, but these examples will suffice to show that the engineering industries are faced with a serious situation.

Funds for Research Work.

WITH the fact fresh in mind that the shareholders of a well-known British manufacturing company recently disputed the right of the directors to allocate funds for research work at universities, the programme of research which has been arranged by the California Institute of Technology is a timely reproach to those responsible for British apathy in this field. The most pleasing feature of this latest American development is the willingness to provide funds to secure the services of the best men available for scientific investigation. Such subjects as the transmission of power at high voltage and the constitution of matter and its relation to the phenomena of radiation are, *The Times* reminds us, to be attacked with the aid of ample financial resources and the assistance of men of international reputation. The satisfactory feature of the situation is that one of the Edison commercial companies—the Southern Californian—is co-operating with the University in the promotion of the research work. It is significant, too, that the investigations about to be undertaken do not promise to yield any immediate commercial result. The real scientific spirit is behind a movement of this character.

Chemical Strike Averted.

COMMON-SENSE has prevailed, and there will be no strike in the chemical industry. At a meeting convened by the Labour Ministry this week the proposed wages reduction was the subject of frank discussion, and a settlement of a dispute which threatened to assume a serious character was brought about. The method of compromise adopted was to make the wage cut of 2d. per hour by two instalments, the second of which will take effect from October 1st. It was also decided to take measures to bring about the stabilisation of wages until the end of the present year.

Austrian Hydro-Electric Schemes.

AN ambitious programme has been framed for the development of water powers by the municipality of Vienna. The first section of the plan, particulars of which have just been issued, is for the utilisation of powers in Lower Austria with a transmission line of 125 miles to supply the immediate needs of the city of Vienna. The cost is estimated at £1,000,000, but the whole scheme will involve an expenditure of £3,000,000. The intention is that all the heating and lighting and power requirements of the capital city shall be met by hydro-electric developments. The attempt to interest foreign capitalists has not hitherto met with any success, but the search for outside financial aid is to be continued, and there are apparently great hopes that when the scheme is examined by experts the necessary capital will be forthcoming.

British Steel Makers' Protest.

As announced in a recent note on this page, British steel makers have taken the unusual step of making a personal protest against the duties on British exports to the United States which would be imposed if the Fordney Tariff Bill became law. It will not be contested that such rates as are proposed on pig iron and the special steels which are exported by Sheffield manufacturers to the United States are in actual restraint of trade and not merely protective duties. When the deputation appeared before the Senate Finance Committee on Tuesday last Mr. Arthur Balfour contended that if the rates proposed by the Bill for high-speed steel and tungsten came into force the old intimate business relations between Sheffield and America would be broken. Definite suggestions were put forward for a reduction of the duties proposed by 50 per cent. The Senate Committee will report in due course, and it is impossible to forecast what may be the character of its recommendations. Members of the Committee were, however, clearly impressed by the arguments of the British deputation. The appearance of foreign manufacturers before the Committee is, of course, an innovation.

Engineering Scholarships.

REGULATIONS have now been framed for the scholarships in civil engineering, funds to establish which were bequeathed by the late Sir Francis Dawnay to the London County Council. It has been decided to award one scholarship each year to candidates between 16 and 18 years of age who have passed or are exempt from the Matriculation examination of the University of London. The scholarships will be tenable for two, and in some cases for three years at the Northampton Polytechnic, Battersea Polytechnic, and the Finsbury Technical College, which has now passed under the control of the London County Council. The first award will be made in the ensuing autumn term, and will consist of a maintenance grant of £110 a year out of which the student will be required to pay his tuition fees.

A New Industrial Village.

AN opportunity has been given this week of inspecting the industrial garden village of Cubley, which is being built on the hills overlooking Penistone. The scheme, which was originally planned by Cammell Lairds for the accommodation of the men employed at the Penistone works of the company, was afterwards taken over by the local Council under the provisions of the Ministry of Health Act. Nearly one hundred houses have now been completed. The village is quite a noteworthy example of enterprise in the direction of providing accommodation for the industrial classes in healthy and comfortable surroundings, and the houses, which were designed before types of industrial dwellings were standardised, have a character which is sometimes lacking in garden villages. It was intended to continue building operations, but the *volte face* in Government housing policy has placed the local authority in a difficult position, and further developments at Cubley are likely to be retarded. The board of Cammell Lairds being, like all those who have the conduct of great enterprises, aware of the close relation between industrial efficiency and good housing, has indicated its willingness to present the site for an extension of the village if the Council can undertake building operations. It is hoped that it may be possible to overcome the financial difficulty, but the method to be adopted has not yet been revealed.

Payment by Results.

THE attempt to combine time rates with the system of payment by results has led to a curious situation at Scunthorpe, where a housing scheme for the industrial population is the subject of a large contract. Arrangements were made with the bricklayers engaged on the job to receive the local union rate, plus a surplus for any output over standard, and under this system not only have the men been earning more than union rates of pay, but have been making more rapid progress with the erection of the houses. This satisfactory condition of affairs, however, would appear to have contravened the regulations of the Operative Bricklayers' Society, which has denounced the arrangement made as an acceptance of the piecework principle, which, it is naïvely stated, leads to scamped workmanship, and cannot therefore be tolerated. Some hundred of men who were quite well satisfied with their jobs have, in consequence, been compelled to strike, and the union officials have announced an intention to keep the men out until the iniquitous system under which they receive a bonus is abolished. This is a typical example of the manner in which trade unions are adding to the difficulties of a perplexing industrial situation.

Foreign Iron and Steel Trades.

CONFLICTING opinions prevail as to conditions in the continental iron and steel trades. The latest pronouncement is that of Mr. Ambrose Callighan, of the National Federation of Blastfurnacemen for the North-West Coast, whose views are based on a visit to Germany, Northern France and Luxembourg, from which he has just returned. He states that unemployment in the blast-furnace section of the foreign industry is acute. If the foreign manufacturer can assemble the raw materials at the works cheaper than the British ironmaster, then, he asserts, the fault lies in the British railways. The geographical situation of the home industry is, Mr. Callighan asserts, the best in Europe, but we apparently rank behind our foreign rivals in works organisation, equipment and management. This criticism is not, of course, new, and its accuracy is certain to be challenged.

State Liability to Railways.

WITH the issue of the statement of the liability of the State to the railways for the month of July it is possible to estimate with a fair degree of accuracy the amount the Government will be called upon to pay for the four and a-half months of the present financial year, over which the Government guarantee extends. In July, for the first time since the coal strike, receipts from the railways showed a small credit balance over working expenses, but in order to make the net revenue up to the guaranteed figure the Government will be called upon to pay for the month of July a sum approaching five million pounds. For the four months of the financial year to the end of July the Government liability is over 33 million pounds. There will probably be a slight addition for the August period, the exact figures for which will be available in the near future. After these are announced, it will be necessary to await with patience for information as to what is being achieved by railway managements in restoring the old-time prosperity of the companies. This will turn to a great extent upon the success attained by those responsible for railway working in effecting economies in operating costs which is to a large extent a task for the engineer.

Incorporated Electrical Engineers.

IT is becoming a regular custom for engineering institutions to take the necessary steps to obtain a Royal Charter. The latest of the big societies to seek a charter of incorporation is the Institution of Electrical Engineers, and the petition to the Privy Council with this object was, it has just been announced, granted at a meeting of the Council held last month. His Majesty the King has intimated his willingness to become patron of the Institution.

A Birmingham Switchgear Works.

OF the firms that have set out to manufacture switchgear for use under arduous conditions, such as those met with in factories and mines, few, if any, have been more successful than that of George Ellison, of Birmingham. Though the firm has not been in existence a great number of years, it has built up an extensive business, which even in these days is in a flourishing state. Originally Mr. Ellison commenced in Birmingham on a very small scale, but the merits of his designs were soon recognised, and additional factories had to be sought. Further growth of the business, however, necessitated the erection of a new and spacious building at Perry Barr, where the whole of the work is now carried out under admirable conditions.

During a recent visit to this new establishment, we were afforded an opportunity of studying the details of the switchgear which the firm constructs and of inspecting the workshops. From the outset Mr. Ellison has adopted the plan of paying his men on a time basis which has proved satisfactory to all concerned. Every endeavour has been made to make the working conditions congenial. The shops are well lighted and well ventilated, and there is an excellent canteen. From the views of the works—Figs. 1 to 4 and those on page 242—a very fair idea of the general character of the establishment can be gained, and it will readily be perceived from the pictures of the various shops that the working conditions are good. Whilst the factory does not contain anything exceptional in the shape of machine tools, the firm's methods are not in any sense antiquated. Mass production of the American variety is not resorted to, but all parts are standardised, and large quantities of small components are stocked. Parts, such as dashpots for use in time lag devices, are turned out practically complete from the metal bar on turret lathes. In the stores the stock of raw materials is never allowed to fall below a fixed minimum, and the same applies to the stock of finished parts, which are collected and taken to the assembly department as required. A good quantity of finished and partly finished switchgear is kept in stock to fill urgent orders, and a view of the stock room containing this gear will be found on page 242.

The success which Mr. Ellison has acquired is unquestionably due to the ingenuity he has brought to bear upon the design of his switchgear and to the soundness of construction. Switchgear turned out of the Perry Bar works conforms in every way with present-day industrial requirements, being fool-proof, dust and water-proof, robust, simple and compact. Among the special devices embodied in this switchgear is a roller contact, which is used in place of the ordinary flat laminated spring contact. This form of contact is used on many of the switches constructed in Mr. Ellison's works, and there seems to be no doubt that it is a very excellent contact. In the case of slip-ring induction motor starters, for example, the resistance is cut out of the rotor by three copper rollers pressed on to the usual segments by means of springs, and as the rollers revolve, the point of contact is constantly changing, thereby greatly minimising arcing troubles. The heavy copper rollers are free to rotate and swivel on copper ball joints carried on a brass spider, and the rollers are therefore self-seating and self-aligning.

Most of the switchgear going through the works on the occasion of our visit appeared to be alternating-current gear, but there was also a considerable number of direct-current switches, &c., under construction. The firm's totally enclosed air break circuit breakers for use on house service mains instead of fuses and for use in mills, factories, workshops and non-gaseous mines, constitute useful and noteworthy products. Each breaker is provided with a "free" handle, which serves for closing the circuit and for quick break hand release. These circuit breakers are made for dealing with 65 or 110 ampères, and in the single, double or triple pole types. When the breakers are intended to be used on direct-current circuits magnetic blow-outs are fitted. The breakers are assembled in cast iron boxes, which are dust and water-proof, and the current-carrying parts are supported on insulated steel rods. Switchboard air break circuit breakers turned out by the firm are constructed on practically the same lines as those which were selected for use on the Paris tramway system in 1899, as experience has shown that the design is thoroughly good. These breakers, which are supplied in numerous combinations of the single, double, triple and four-pole patterns and with or without magnetic blow-outs, are either provided with a protecting covering or the parts are left exposed. Every form of automatic device is provided and the breakers are made to satisfy any specific conditions. In all, they are made in six standard sizes, the largest dealing with 3500 ampères. Finished parts for any of these breakers can always be supplied from stock.

The Ellison unit type switchgear, which we also had the pleasure of inspecting, is made for all industrial applications, and is intended to bridge the gap between the ordinary switch and distribution board and the cellular switchboards as used in large power stations. The standard oi break circuit breakers and starters lend themselves to the building up of quite complicated arrangements, yet each part is simple and robust. The units are supported on cast iron stands and are bolted together to form a compact totally enclosed, weather and fool-proof switchboard, which will withstand the roughest use. The circuit breakers belonging to each unit are bolted to a steel plate chamber, which contains the isolating switches and bus-bars, and supports the necessary instruments. Between the isolating switches and circuit breakers interlocking devices are provided.

For the control of cranes, Mr. Ellison has developed a special system for alternating or direct-current

FIG. 1—RAW MATERIAL STORES

FIG. 2—SMALL PARTS STORES

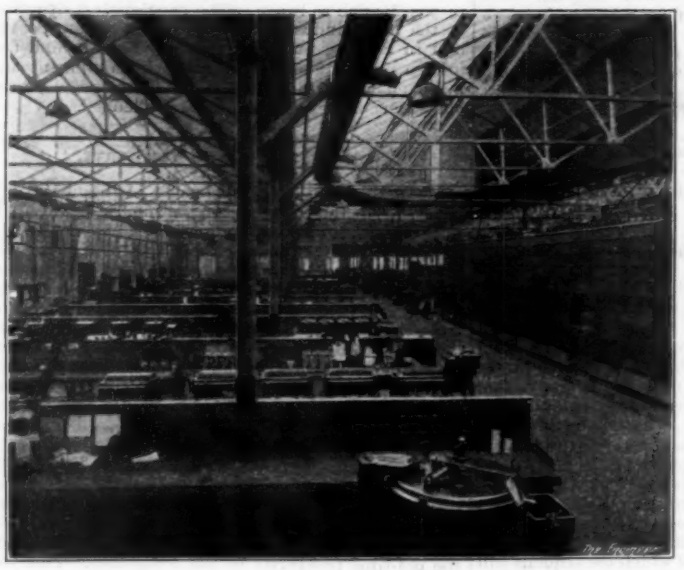


FIG. 3—ASSEMBLY BENCHES

FIG. 4—ASSEMBLY BENCHES AND PART OF MACHINE SHOP

working, involving the use of switch panels—see Fig. 5—the gear on each of which, consists of a main air break circuit breaker, with overload and no-volt releases, and capable of breaking the circuit with safety under the worst conditions, and also capable of isolating the whole of the electrical gear on the crane in the event of the supply failing. An overload inverse time element relay in the circuit of each motor trips the main breaker when the motor is overloaded or when it fails. There is also a pilot lamp with a plug socket and switch, and if necessary the panels are provided with indicating instruments.

troller type, with easily renewable contact fingers and segments, and all live parts are supported on insulated steel rods and are enclosed in a cast iron frame with a sheet iron inspection cover. Owing to the provision of a correct sequence device, the switch is fool-proof, and the contacts must be completely home in the starting position before the handle can be moved over to the running position. Complete control panels are composed of a starter fitted with a no-volt release, fuses mounted in a separate cast iron box, and having its cover interlocked with the starter handle and an ammeter fixed above the starter.

dial without relieving the pressure on the other rollers. The resistance elements are composed of a high resistance alloy wire with negligible temperature coefficient, and the wire is bound on strong stoneware cylinders. A slow-motion operating device ensures quick movement from contact to contact, but at the same time it is impossible for the operator to cut out the resistance too rapidly.

Lastly, a product which we should not omit to mention is the firm's totally enclosed oil circuit breaker—shown in Fig. 6. These breakers are designed for all industrial purposes, and are especially intended for use in factories, collieries and other places where dust and damp-proof switchgear is required. The current-carrying parts are enclosed in a massive cast iron case and oil tank, which are joined together by a grummet. All the contacts are mounted on a slate base, bushed and insulated with mica. The arcing contacts are well submerged beneath the surface of the oil, which is poured in through a hole in an inclined boss on one side of the tank, and the oil inlet is closed by a wood plug, which in the event of the oil pressure rising unduly when heavy currents are interrupted, acts as a vent. The operating lever which closes the breaker is a massive gun-metal handle, and a brass knob is provided on the cover for releasing the breaker by hand. Series overload trip coils with time lags and other automatic devices are fitted to meet requirements.

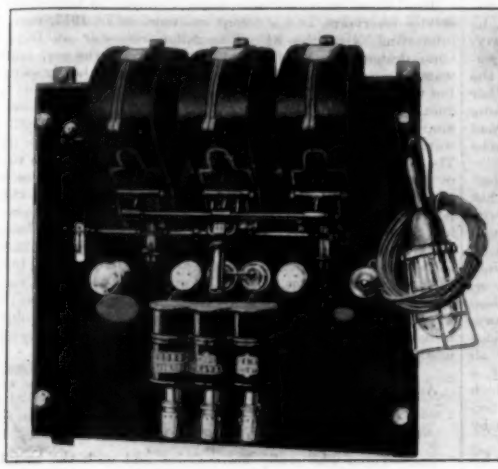


FIG. 5—CRANE CONTROL SWITCH PANEL

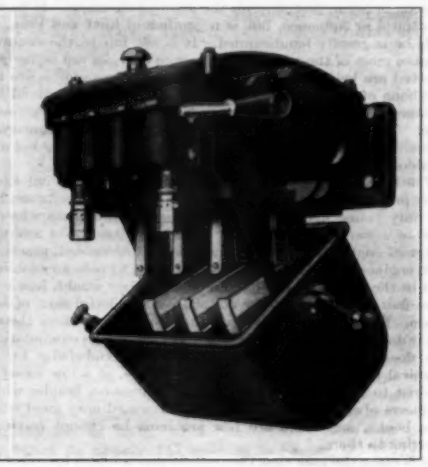


FIG. 6—OIL CIRCUIT BREAKER

By using only one circuit breaker, the number of elements is reduced to a minimum, and easy manipulation is secured.

Drum type controllers for alternating and direct-current motors—as shown in Fig. 8—are also being turned out in considerable quantities. These controllers, which are suitable for the operation of cranes or for any purpose involving frequent starting and stopping, have liberally dimensioned contact segments, which can easily be replaced when worn. The fingers which make contact with these segments are adjustable and are fitted with renewable tips. Arc shields and magnetic blow-outs are fitted. The contact fingers are arranged radially with respect to the barrel, and the roller tips are pressed into contact with the barrel by springs. This design, which is, of course, a departure from orthodox practice, is claimed to present several advantages, for, as the rollers are mounted so that they can rotate, oscillate and lift, they bed themselves perfectly on the drum segments. Controllers are being turned out by the firm for practically every type of direct and alternating-current motor.

The Ellison control panels for induction motors are very robust units, and like other of the firm's products, comply with the requirements of the official regulations, and are suitable for use in many kinds of industrial establishments. The circuit breakers and starters are really independent units, but they are interlocked and have automatic devices and fool-proof operating gear. By separating the component parts in this fashion a very good design is secured, and inspection, repair and cleaning are facilitated. There are three types of these control panels for induction motors. The "mill" type has a totally enclosed air break circuit breaker with automatic trips, and is electrically interlocked with an air-cooled starter of the face-plate variety. The breaker is suitable for line currents up to 110 ampères at 650 volts, whilst the starter will deal with rotor currents 225 ampères or 55 brake horse-power. All the gear is mounted on an angle iron frame, which can be fixed to the wall. Floor stands are, however, also supplied.

Another control outfit for slip-ring induction motors has an oil break oil-cooled starting switch. The breaker, which is of the firm's standard type, is fitted with full automatic releases, and is made in three sizes, the largest size having a capacity of 800 ampères. The oil-immersed starter has wire-wound resistances, roller contacts and slow motion operating mechanism, and is made in sizes up to 1500 horse-power. A simple mechanical interlock can be provided between the breaker and starter, or various electrical interlocks may be utilised. The third type of induction motor starting unit is an auto-transformer switch, designed for starting squirrel-cage motors up to 200 horse-power. The equipment comprises an oil break circuit breaker, with automatic releases and time lags, which give full protection, and an auto-transformer in a separate oil tank, and this transformer is electrically connected to an oil break change-over switch, which is fitted with the firm's "Gradatim" device for ensuring correct sequence and time in starting, and is mechanically interlocked with the circuit breaker.

As the transformer is only in use during the starting periods, it is highly rated. Oil break star delta starters are made as shown in Fig. 7; also air break star delta starters. The latter are of the drum con-

The oil break star delta starters are also fitted with full automatic releases and time lags on the overload trips, and therefore contain all that is necessary to start, stop and protect squirrel-cage motors. The starting handle can only be moved in the proper sequence, and with a pause at the starting position before the switch can be thrown over to the running position. The overload trips are only operative in the running position, and the time lags permit reasonable trip settings, whilst at the same time prevent the switch being opened by the rush of current caused by changing over from the starting to the running position. Oil star delta starters are made for currents up to 200 ampères.

FIG. 7—STAR-DELTA STARTER

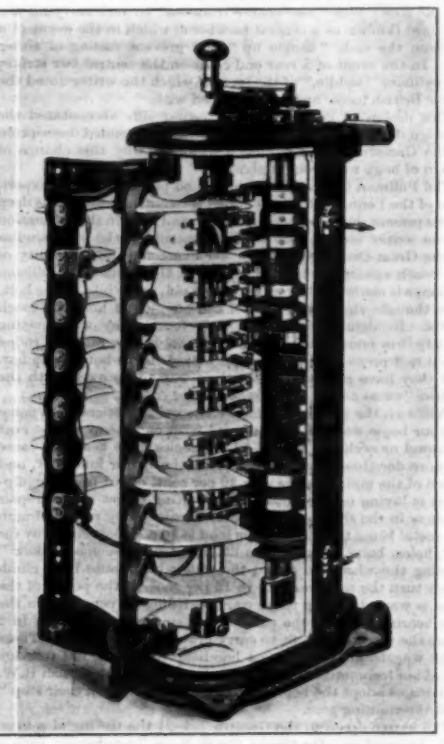


FIG. 8—DRUM CONTROLLER

Oil-cooled rotor starters are built in capacities up to 1500 brake horse-power and 1000 ampères, rotor current. All the contacts and resistance elements are completely submerged in oil, and the contact dial is at the bottom of the tank and under a very ample head of oil. The moving contacts are, as previously mentioned, free to rotate and swivel on copper ball joints, carried on a brass spider, and they are forced against the fixed contacts by strong springs, so placed that each roller is positively controlled, and can surmount a rough part or other obstacle on the contact

THE INSTITUTION OF MINING ENGINEERS.

THE thirty-second annual general meeting of the Institution of Mining Engineers will be held in the Town Hall, Stoke-on-Trent, at 11 o'clock on Wednesday, September 14th. The following papers will be read or taken as read:—(1) "The Absorption or Solubility of Methane and other Gases in Coal, Charcoal, and other Substances," by J. Ivon Graham, chief chemist, Doncaster Coalowners' Laboratory; (2) "Suggestions for the Standardisation of Geological Sections of Strata proved in Bore-holes, Shafts, &c.," by Harry Roscoe; (3) "Coal-mining by Steam Shovel in Alberta, Canada," by George Sheppard.

The following papers, which have already appeared in the *Transactions* of the Institution, will be open for discussion:—(*a*) "Third Report of the Committee on 'The Control of Atmospheric Conditions in Hot and Deep Mines': Observations of Temperature and Moisture in Deep Coal Mines," by J. P. Rees, Vol. lxi., page 101; (*b*) "Characteristics of Outburst of Gas in Mines," by Professor Henry Briggs, Vol. lxi., page 119.

In the afternoon there will be an excursion for ladies only to the china works of Cauldron, Limited. In the evening there will be a dinner in the Town Hall. On Thursday, September 15th, there will be alternative excursions to (*a*) The Whitfield Colliery at Norton-in-the-Moors, and to the works of Kerr, Stuart and Co., Limited; (*b*) the collieries and works of the Shelton Iron, Steel and Coal Company, Limited, at Etruria; (*c*) (for ladies only) the china works of Josiah Wedgwood and Sons, Limited, Etruria; and (*d*) (also for ladies only) to the silk mills of William Watson, Limited, at Leek. In the evening there will be a reception in the Town Hall at the invitation of the North Staffordshire Colliery Owners' Association. On Friday, the 16th, a tour round the North Staffordshire coalfield will be made in motor conveyances.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE TELESCOPING OF RAILWAY TRAINS.

SIR,—Yours of 7–1–21 describing what is termed "Anti Telescoping" device on passenger stock on the Great Cent. R.M. noted with interest, due to heavy equipment and long trains (pass) now becoming the rule in G.B.

The problem in the states and Canada is with heavy freight trains to overcome telescoping and spilling over on the other tracks thereby tangling up other trains.

The "curry comb" anticlimber has been equipped here for some years on the "Sub" and "El" and it was thought they would "cut the mustard." However they now find they were deluded into a "false security" since on the Bronx end of the 3rd Avenue El there were 3 collisions on which 3 motormen were killed in which the cars were equipped with the so-called "anti-climbers."

The cars in the above collision were 50–50 wood and steel. The momentum of 8–car trains was such the "anti-climbers" rolled up and cars telescoped 6 to 8ft. The unfortunate motormen did not have time to "jump back."

When the "anti-climbers" were first equipped they were put on wooden cars. Incidentally there happened to be a collision in which the cars so equipped did not climb and the cars not so equipped in the same train did climb and telescope, thereby deluding the authority into the "false security." The writer regrets the "G. Cent." authorities would be tempted to place dependence of the safety of the passengers on this device and reinforcement of the end of the coach as described adding useless tonnage on motive power which is now being "loaded down" to the last ton.

Since it was found that the anticlimber would roll up, the underframe of the lightest coach that would raise up would shear off the reinforcement and telescope, as it was found by the Pullman Co. here. Also if struck from the rear the boiler of the loco. would drive in the reinforcement which in turn would buckle up the end of the floor frame, then the cylinders and saddle would plow under the floor frame resulting in the loco. telescoping the car.

The writer is further surprised the Cent. would place dependence in wooden cars in the light of past experience on both sides of the Atlantic. The Pullman Co. was loath to abandon the wooden car finally adopted a 50–50 design wood and steel as they were desirous of retaining the appearance of the wooden coach "roughneck" rivets were good enough on a loco. tank but was not "high brow" enough for a pullman. However 1909 was a severe winter with numerous rear end collisions, which was a good demonstration of various types of steel coaches. In the last design the Pullman Co. abandoned all the "ginger bread" ideas, such as eliptic fancy glass in the windows and gold stripe in their endeavor to design a car that would not be telescoped by the loco. in the event of a rear end collision.

The telescoping at Abermule is a sample of what has happened here hundreds of times. The loco. express and mail cars act as a buffer block, the weaker cars in the center of train act as a cushion and are telescoped and buckled up by the momentum of the heavy cars in the rear.

The only design of none telescoping coach the writer knows is the Pennsylvania R.R. which has a box 15 by 18in. (these cars are all steel) under the center from end to end carrying the platform (known as a central backbone) which in the event of a collision the ends "tangle up" and prevent raising of either car. In the event of a rear end collision the central box strikes the cylinder "saddle," of the loco. of which the writer noted the larger British locos are now equipped with.

This design of Penn. R.R. box center sills necessitated the redesign of the bogy of which there was an extended description in the Gazette (R.W.) but no mention of why this change of design of bogy was brought about.

The Pullman Co. as before mentioned profiting by the experience of the Penn. R.R. has designed a "cent backbone" as deep as the present design of bogy would permit, and in the estimation of the writer useless heavy reinforcement on the ends similar to the Great Cent. Also to further overcome the possibility of the coach raising up from the bogy in the event of a collision a change is made by the center or king pin, made into a fang bolt. It is thought that the weight of the bougy will hold the coach down. Incidentally with this they found they were getting "rusty" in bougy design. The pedestal is now made of rolled metal and pressed into shape and bolted to the bougy sole bar. But they have not as yet seen their way to do away with the useless "swan neck" heavy equalizer.

While on the subject of bougies the writer noticed that some of your bogie wagons are equipped with our cheap at first cost diamond or arch bar bogie. These bogies have been the cause of more derailments and wrecks that the writer knows of, and is one of the main reasons why 20 per cent. of our freight equipment is laying on the dead tracks waiting to get on the repair track or in the shop or the bonfire. Designed by rule of thumb the metal being too light for the load is 40 per cent. cut away for bolt holes, bolts being a loose fit. The truck becomes "skew" causing the wheels to crowd the rails which cause it to climb if not turn the rail over. 10 to 15 per cent. of the power of the loco. is wasted pulling those wagons, riding 50 per cent. on the side bearings, rattles the car body to such an extent that in 2 years the wagon is not fit to carry grain or merchandise. These weak wagons are the greatest handicap to getting full tonnage out of our locomotives. The writer hopes when the British R.W. authorities adopt the bogie wagon they will "watch their step" with the running gear.

The writer noted in the Gazette 7–1–21 the testing of a loco. with 18 coaches. He thinks the G.N. is "monkeying with a buz saw." If there was a head end collision or engine derailed those wooden coaches would pile up and telescope due to the momentum, or a rear end collision the coaches at the rear would telescope due to the resistance of the heavy weight in front.

Trusting the above is comprehensive otherwise will give further details.

JOHN FRANCIS.

August 3rd.

[We confess our inability to edit this instructive letter, and print it as received.—ED. THE E.]

THE PROSPECTS OF YOUNG ENGINEERS.

SIR,—At the present moment there are a large number of engineers of proved ability who are out of employment, yet our technical colleges and universities are full of young men who are being taught the theory of engineering. The question therefore arises, What is going to happen to these young men if fully qualified engineers cannot find employment?

Such a state of affairs does not seem fair either to the parents of the young men, nor to the young men themselves, nor to the country. It is not fair to the parents, because the cost of making their sons engineers is considerable, yet the majority of these parents know nothing about the engineering profession, and few have either influence or capital to help their sons on with, yet it is in the engineering profession that influence and capital are required more than in any other profession. It is not fair to the sons, because the money which the father spends on his education is his capital, yet it is being sunk in a profession in which the chance of the son being able to make a decent living is slight. The engineering profession is the hardest of all professions to learn, and requires the greatest sacrifices. If he has no capital or influence, but is a gentleman bred and born, he finds he is greatly handicapped. It is not fair to the country, because most of these young men whose energies are being misdirected are being drawn from the middle classes, who are the backbone of the British Empire. If England is to uphold her greatness, she must see that the best use is made of every young man. The British Government is always greatly concerned about the training and welfare of her workmen, but she troubles little about the middle classes.

The Institutions of Mechanical Engineers and of Civil Engineers pretend to watch over the training of young engineers, but the only young men they have any use for are those who are good at answering conundrums at examinations. Yet many of the great engineers in the past have been hard-headed, practical, born engineers, who, if they had been asked to pass an examination in theory, could not have done so; they would, however, have flattened the proposer out with a wonderful flow of language. No engineer will ever say that we can do without theory, but it does not follow that because one cannot pass examinations one does not possess sufficient theoretical knowledge for all practical purposes. One can always engage, at a low salary, a theorist to work out one's intricate calculations, besides which engineers always possess a library of extraordinary good reference books, and there are few problems he cannot solve by referring to them.

It is often the case that the more letters a fellow has after his name the more unpractical he is. My contention is that there should be a Government Department to deal with the training of our young men. That before any young man takes up a profession, he and his parents should be interviewed by this Department, who will explain the prospects in each profession, advise what branch to take up, and the best plan of training to adopt. That the training should not be allowed to begin without a permit from this Department. This Department would keep *au fait* with the requirements of the various professions; it would therefore be able to see that no one wasted his time by taking up a profession which was already overcrowded, because, after all, each young man's time and capital is part of his country's capital.

ECHO,
Mechanical and Civil Engineer.

Dulwich, August 29th.

THE JUNIOR INSTITUTION OF ENGINEERS.

SIR,—So many of your readers have an interest, either benevolent or active, in the affairs of the Junior Institution of Engineers, that I feel no excuse is needed for asking the hospitality of your columns for a brief expression of regret at the change of policy to which the Institution has just pledged itself.

As I understand the position, the old governing policy of "by Juniors for Juniors" has been cast overboard, and new articles of association have been adopted, which, in intent, if not in fact, bring the Institution into competitive line with the senior representative bodies of the profession. There is no need for a new senior body; there is every need for a continuation of the splendid work which the Institution has done for the younger members of the profession, when conducted in the real "Junior" spirit.

As a member whose connection with the Juniors goes back to the "eighties," and who still has a great admiration and affection for their traditions, I should like to express the hope that the engines will be reversed till the ship is back on her old course, and that she may then go full speed ahead again. If any change at all is to be made, I suggest for consideration that no member should hold executive office after reaching the age of twenty-six; I would even go further and suggest that *all* members, on reaching the age of twenty-six, should be placed on a "retired" list. They could still actively assist the Institution and its real Junior members in many ways, as some of us "old fogies" do, without feeling that they were in any degree out of place in a "Junior" Institution. Thus the old and successful policy "by Juniors for Juniors," the policy which gave the Institution its unique and widely respected position in the engineering world, would be effectively restored.

I am sure that the many readers of THE ENGINEER who wish the Institution well will watch with some anxiety the changes which are now threatened.

PERCIVAL MARSHALL.

London, August 24th.

THE COST OF COVERED SERVICE RESERVOIRS. BIRKENHEAD'S ALWEN WATER SUPPLY.

SIR,—Referring to your recent article, the writer would say that he has visited the works on two occasions, and is very well acquainted with the Birkenhead neighbourhood.

The design of the Cross Hill reservoir is stated to be unique and to be probably the most economical reservoir ever constructed. Mr. Binnie, in his paper on this reservoir before the Institution of Water Engineers in 1916, stated that due to its unique design the cost per million gallons available capacity had been reduced to about £2800 per million gallons, against £5000, the usual cost of construction in the London neighbourhood. [These are, of course, pre-war figures, as this contract was let in 1913.] In the discussion it was pointed out by a speaker that it was misleading to compare the unit cost of this large structure with the unit costs of much smaller structures. Further, the Cross Hill site is an ideal one for economy.

The writer has designed large covered service reservoirs in the New Red Sandstone and other formations during the past twenty-five years, and has thoroughly studied the literature of the subject and seen many constructed. He believes that at Cross Hill the cost could have been somewhat reduced without loss of efficiency by using an ordinary type structure with a reinforced concrete roof. Further than this, in view of the fact that the excavations were in a very hard sand, which many people call sand rock, very considerable economy could have been secured by making the floor of a saucer shape, as in the American reservoir mentioned below and in some English reservoirs.

The only reservoir in this country of comparable size is the Ambergate reservoir, completed ten years ago. This is on a more difficult site than Cross Hill, and the cost was £3400 per million gallons. Not far from Cross Hill we have the 10-million-gallon reservoir at St. Helens, finished in 1904. This cost £2600 per million gallons, and its designer points out that it is much stronger than necessary owing to Government dictation. There are numerous other examples of recent English reservoirs which were moderate in cost compared with the £5000 mentioned above.

The United States contains many examples of large covered service reservoirs, and a recent example, *let in* 1917, may be interesting, viz., the 8¼-million-gallon reservoir at Dayton, Ohio, designed by Mr. Leonard Metcalf, one of the best known water engineers in America. The walls are of very heavy section, but the floor is not rendered or asphalted. The roof piers are 26in diameter, and spaced at 20ft. centres. The roof slab is 8in. thick, and carries 2ft. of earth. There being a depth of water of 26ft. the floor leaked at the rate of 40,000 gals. per day. The cost was about £4100 per million gallons (taking the value of the dollar at 5s.). If the floor had been asphalted to secure absolute watertightness the cost would have been about £4400 per million gallons—about £2000 at pre-war prices for a reservoir less than one-third the capacity of Cross Hill. Common labour was paid 1s. 6d. to 1s. 10d. per hour, and carpenters from 2s. 6d. to 3s. [See *Journal*, N.E.W.W. Association, September, 1919.]

The writer does not wish to be misunderstood. He is well acquainted with the work of Mr. Binnie's firm, and believes that in general there is no more careful firm of engineers. His object in making this communication is not carping criticism but that unsound statements should not go unchallenged.

WATER ENGINEER.

August 30th.

CHINA AND GREAT BRITAIN.

SIR,—Those who really know China and wish the best for Anglo-Chinese relations must be gratified to read Mr. Lenox Simpson's articles, approaching as they do an important question in sincere and helpful manner, evidently expression of authoritative opinion showing knowledge and sympathy which have too rare opportunity for appearance in the Occidental Press; their spirit can be found in permanent form by seekers after truth who care to read the works of fact and fiction written by "Putnam Weale" concerning the Far East.

Experience of many years ago and of late convinces one that China desires opportunity to reciprocate the moral and financially unselfish support of England, but views with distress akin to despair what, to her, appears to be our studied neglect.

Considering "China for the Chinese" in no narrow sense, but as opposed to selfish exploitation, her preference is for assistance through English private effort by group or individual, preferably the latter; subconscious political encroachment and Legational flaunting of national flags are anathema to her, none so quick as she to detect the former.

It is but as yesterday that this sweet-tempered, logically minded, trusting and trustworthy nation received extreme deference from the political emissaries of other countries, a day now past, but the deeply laid foundations of which still remain; frankness and sincerity without superlatives are fully and heartily reciprocated by China, her difficulty is to discern such in those who clamour for her favours, or dictate theology.

Regarding existing markets for characteristic British manufactures, as in heavy engineering, she prefers direct dealing with the engineering heads of firms of aristocratic repute, welcoming personal visits from the supreme direction of such concerns bringing with them imagination, sympathy, long views and ready action.

Superficial and interested observation is prone to declare chaos to be the present state of China; such is not the case. Clearly defined in black, white and the three primary colours flies her flag, emblematic of her condition. Infinite capacities are there; it only remains for her undoubted genius, aided by the artist touch of English engineers and manufacturers to blend these into harmony and character unparalleled; aided, not in her loneliness to be pushed by external "policies" into the maelstrom of the world's opportunism, therein to struggle, clutching despairingly at sham assistance.

CECIL G. HOWSIN,
M.I. Mech. E., M. Inst. Loco. E., A.M. Inst. C.E.

CATALOGUES FOR HONDURAS.—The British Consul at Tegucigalpa—Mr. G. Lyall—has received a request from the Ministry of Public Works of the Republic of Honduras for catalogues and price lists of United Kingdom manufacturers of agricultural implements and machinery. Illustrated catalogues—in Spanish, if possible—comprising ploughs, harrows, seed planters, tractors, &c., for general agricultural purposes, and implements and machinery (hand and mechanical drive) for sugar, coffee and tobacco cultivation and for roadmaking are desirable. Catalogues should be addressed direct to the British Consul, British Consulate, Tegucigalpa, Honduras.

AMERICAN COPPER AND BRASS RESEARCH ASSOCIATION.—The formation of a United States Copper and Brass Research Association, an incorporated organisation of the copper, brass and copper alloy interests, is announced from New York. The purpose of the organisation is to stimulate the use of these metals, and membership in the Association is open to producers of copper sold in New York or selling agents of copper in the United States; to fabricators of copper, brass and copper products generally in the United States and Dominion of Canada; and to others directly engaged in or connected with the copper and brass industries. Thirty of the largest companies have, it is said, already joined the Association.

ALLOYS RESEARCH.—The eleventh report of the Alloys Research Committee of the Institution of Mechanical Engineers has just been issued in book form, and will be presented in abstract for discussion at the first meeting of the session, probably on the third Friday in October. The report, which has been prepared by Dr. Rosenhain, Mr. Sydney Archbutt, and Dr. Hanson, deals with aluminium alloys and occupies 256 pages apart from plates, but, despite its great length, is more condensed than its predecessors. It must be remembered that more than eight years have elapsed since the appearance of the last report, that many of those years were war years, and that during that period the importance of aluminium augmented considerably. The Council of the Institution has acted wisely in issuing the report several weeks before the meeting at which it will be discussed, as thereby speakers will be enabled to give careful study to it. It is being sold at the price of one guinea to members and two guineas to non-members, and is obtainable from the Institution.

Railway Matters.

THE Chilean Government has decided to borrow the sum of £2,700,000 for the purpose of electrifying 200 kiloms. of railway between Santiago and Valparaiso.

THE Saupingchieh–Tsenchiatun Railway is to be extended from the former place to Pai-in-tai-lai, a distance of 72 miles. The whole extension will be completed in October.

THE opening of the football season on the 27th ultimo was accompanied by the restoration of football specials. In all cases the fares charged were at the rate of a single fare for the double journey.

CONSTRUCTION has begun on the Hunan-Hupeh section of the Canton–Hankow Railway from Chuchow to Hengchow. The length is about 80 miles. The first division will be made from Chuchow to Lukow.

DURING control the Midland Railway Company closed its goods stations in Hitchin, Spalding, Cambridge and Wakefield, and allowed the Great Northern to handle all the traffic. With the cessation of control the Midland re-opened these stations on the 16th ultimo.

BEFORE Parliament rose Sir Eric Geddes stated that should Sir Frank Gore-Browne agree to be the chairman of the Railway Rates Tribunal whilst still holding the chairmanship of the Rates Advisory Committee, no addition will be made to his present salary.

THE Federal Public Works Committee left Melbourne on June 8th in three motor cars to cross Australia to decide as to the course of the proposed north-south transcontinental railway. The trip will cost £3000, but the information to be gained will be worth the expense.

THE Inter-State Commission has authorised the railways east of the Mississippi to reduce their export rates on iron and steel products 20 to 25 per cent. The metal industries had urged the reductions on the ground they were necessary to enable Americans to meet competition from abroad.

IT is reported from Stockholm that the Ljungstroems Steam Turbine Company has built a new type of turbine-driven locomotive in accordance with the designs of a Swedish inventor, and that the engine is now being tested by the State railways. The locomotive is also equipped with a condenser and other appliances for economising fuel.

EIGHT bridges are to be constructed in connection with the continuation of the Canton–Hankow Railway. The bridges will require 90 tons of steel plates. Tenders were received from the Yangtze Construction Company (343 dollars per ton) and the American Steel Corporation (374 dollars per ton). The order is to be placed with the former company.

CHESTER Corporation tramway accounts for the past year show total revenue £34,190, working expenses £21,852, leaving a gross profit of £2327. The traffic expenses were £947 greater than the previous year, general expenses £861, permanent way £600, electrical equipment of line £39, cars £1854, and power £640. The average revenue per car-mile was 20.45d.

ACCORDING to the *Electrician*, the Government, on account of lack of funds, has refused to make a State grant towards the construction of the Halwill-Torrington Light Railway. Alternative schemes are already under consideration, and every effort is being made to prevent the railway from becoming derelict. If carried out it would mean employment for three years for between 2000 and 3000 men.

IN the case of the fatal accident to a young man returning from Brighton to London by an excursion train on the evening of the 21st ultimo, the action of the driver in not pulling up until he reached Forest Hill was criticised, but it must be remembered that, as a rule, it is better to stop in a station than between two stations—assistance, if required, is more readily obtained, and the train is protected by the fixed signals and the block system, instead of by the latter alone.

THE outlook for the railways of the United States would appear to be brighter. This is not due to more business, but to economical working. For June of this year there was, when compared with June, 1920, a reduction of 20.7 per cent. in the operating expenses, although the receipts were only 6.7 per cent. less. The roads were 47,295,000 dols., or 47.7 per cent., short of earning the 6 per cent. promised by the Transportation Act, 1920. In May and June of 1920, out of every dollar received, 95.69 and 96.84 cents respectively went in expenses. In May and June this year the respective figures were 85.43 and 82.34 cents.

A MISSTATEMENT of fact was unfortunately made in the paragraph on "Railway Standard Revenue" on the Journal page of our issue of August 26th. The accounts of the subsidiary businesses of the railway companies are kept separately. The traders desire that the standard revenue shall be that derived from "Railway Working" alone and not from the whole undertaking, and it was this point that was adjusted in the Bill. In the year 1913, these subsidiary businesses—steamboats, canals, docks, harbours, hotels, &c.—produced receipts exceeding the expenditure upon them by £2,059,353. In the financial year ended March 31st last they had a loss of £1,163,869. For this result the depression in trade last winter and the coal dispute were responsible, as, as late as last September, they were making a profit.

WE hear that a Committee of the Ministry of Transport is shortly to visit Liverpool to inspect a new system of railway signalling which has been adopted by the Liverpool Overhead Railway Company along the five miles of double track between the Alexandra and the Herculaneum Docks. Automatic electric lamp signals have been substituted for the semaphore arm signals, and an advantage is that even in broad daylight the signal is more easily seen than the ordinary signal arm. The Liverpool Overhead Railway Company now employs twenty-six of these new signals, which are worked by the trains themselves switching on the respective lights behind the coloured lenses. If the train runs past a signal set at danger, a circuit brake comes into operation, and by cutting off the power and applying the train's brakes, pulls it up within 300ft.

Notes and Memoranda.

IN connection with the investigation at the Imperial Institute of spent wattle bark as a paper-making material, it has been reported to the Committee that a company in Natal is now making arrangements for the production of paper from the spent bark obtained from the tannin extract factories.

TESTS recently carried out in Canada show a decided advantage in using a proportion of crusher screenings with clean limestone in concrete mixtures. It is, of course, pointed out that no correct general statements concerning the use of limestone crusher screenings could be made without very extensive investigations, but justification is claimed for stating that the presence of crusher screenings in crushed stone up to 20 per cent. is far more likely substantially to increase the strength of the resulting concrete than to decrease it.

A MACHINE was rigged up recently in an American factory for testing the wearing qualities of shovels. It comprised a rotating axle and four arms in which the shovels were fastened. The machine was driven with a 3 horse-power motor with the speed reduced to 14 revolutions per minute. The shovels were forced through more than 3ft. of red granite rock. Over 125,000 revolutions through the granite rocks, or a distance of more than 75 miles, were made by some of the steel shovels without the blades breaking or straps pulling loose. Based on the tonnage of material handled per shovel, this indicates that one shovel would have handled 3400 tons.

THE annual report of the Shanghai municipal electrical engineer shows that, notwithstanding the very adverse working conditions caused by a shortage of plant, and the final breakdown of the two German alternators, which have now been discarded, the net sales of electricity for all purposes increased in 1920 to 144,540,000 units from 102,338,000 in 1919, while the energy sold for power increased to nearly 117 million units, or about 47 per cent. more than in the previous year. All former records were thus surpassed. This was in some part due to the large number of mills and industrial establishments that were connected, including six cotton mills with an aggregate of 140,000 spindles.

THE accounts of the Glasgow electricity undertaking for the year ended May 31st show that considerable progress has been made, notwithstanding the unfavourable working conditions. It appears that the gross revenue for the year ended May 31st was £1,311,951, compared with £977,486 in 1920, and that the working expenditure was £902,425, against £713,451. After meeting interest and sinking fund obligations, and writing off £67,161 for depreciation, there was a net profit of £2730, compared with a deficit of £54,614 in the previous year. The result would have been much more favourable but for the breakdown of the new generators at Dalmarnock in mid-winter, when the demand was at its highest, while the coal strike also adversely affected the revenue.

THE Departmental Committee appointed to inquire whether it is necessary or desirable to prescribe any limitations of the proportion of carbon monoxide in gas supplied for domestic purposes have come to the conclusion, on the balance of advantage to the public, that they are justified in recommending non-limitation. In a report issued recently the Committee says it has not ignored the increased risk from the poisonous nature of carbon monoxide, but, when all practicable precautions are adopted, it does not consider the increased risk will be found serious. The danger of increased death-rate is in any case small, and against it must be set the certain improvement in the public health by the reduction of smoke and fog arising from increased use of gas.

THE results of recent tests at Leeds Corporation tramway power station into the relative costs of coal and oil fuel show that oil is yet a long way from beating coal in this respect. Eight boilers had been converted to the use of oil during the coal strike to maintain the tramway service. Both the Gretna type burner—two per boiler—and the Johnson type—four per boiler—were used. The cost was 1.115d. per unit of electricity generated, as against the average cost of coal, based on last year's figures for the same boilers, of 0.560d. per unit. After making allowance for labour saving, it was found that in order to compete with coal at £1 16s. per ton, oil would have to be obtainable at £2 17s. per ton, or £2 19s. per ton to compete with coal at £1 17s. 6d. As a matter of fact, the cost of the oil fuel worked out at £5 5s. per ton.

A HARDENED steel ring gauge 1in. long was ground and lapped out at the National Physical Laboratory until the internal diameter was 1.0000in. The outside diameter, which was 2in., was ground true. A plug gauge was ground and lapped down until it could be inserted into the ring, using ordinary hand pressure, and with both the gauges clean and free from any trace of grease. The size of this plug was found on measurement to be 1.0000in. A second plug was then made whose diameter was 1.0002in. This plug refused to enter the ring so long as the surfaces were kept dry and free from grease, but when lubricated with vaseline it was found possible to assemble the two gauges by ordinary hand pressure. By measuring over its outside diameter both before and after the plug had been inserted, it was definitely proved that the ring had been stretched in the process of inserting the gauge.

SENATOR G. MARCONI, addressing the annual meeting of the Marconi Company, held in London recently, said that wireless service in all parts of the world had hitherto been subjected from time to time to interruption from two causes—one, interference from other wireless stations; the other natural electrical disturbances, which were generally known as atmospherics, or "x's." The company had devoted itself to a great deal of research work, with a view to surmounting both these obstacles. Wireless engineers throughout the world had been incessantly studying this difficult problem for many years. The company's technical staff, with his personal assistance, had made great strides in this direction, resulting in improvements and inventions to which he attached the greatest importance, and which inspired them with the belief that these difficulties were also being successfully mastered.

Miscellanea.

WE are informed by the Department of Overseas Trade that the Samples Fair, which was to have been opened in Trieste on September 11th, has been postponed until May, 1922.

THE Japanese Government has erected two new wireless stations at Okinawa (Liu-kiu Islands) and Kogoshima for ship traffic. Military and naval stations are to be built at Hokkaido and Otaru, at a cost of six million yen.

WIRELESS telephony was employed for practical purposes for the first time in India on August 18th, following on recent successful experiments by the Posts and Telegraphs Department. The results of races at Poona were telephoned by wireless to Bombay with complete success, despite adverse weather conditions.

PLANS are under consideration for the construction by Yukon and Federal authorities of a network of highways which will greatly enhance development in the country. It is intended to join the Alaskan and Yukon road systems at an early date. Investigations are being made by the Government in connection with the construction of a 500-mile road from Camp Mayo to the Fort Horman oil-fields.

THE city of Vienna, in conjunction with a banking syndicate, is forming a company with a capital of half a milliard crowns to develop water power near Vienna sufficient to supply the city with electricity. The cost of construction will be covered by an issue of bonds aggregating ten milliards of crowns, about one-third of which will be issued in the first five years. It is hoped to begin the preliminary construction in November.

ARRANGEMENTS are now being made by the Institution of Automobile Engineers for holding a series of informal meetings before the London, Birmingham, Manchester, and Glasgow Centres during the winter. These meetings are designed to bring before the members new accessories in connection with the automobile, such as tires, carburetters, easy starting devices, and such like, and to allow of their advantages being freely canvassed and discussed.

THE Manchester City Council has adopted a recommendation by the Waterworks Committee to the effect that the northern portion of the Ribble water syphon, in all 4¼ miles of reinforced concrete pipes, should be built at a cost of £206,023. This is part of the fourth pipe line from Thirlmere Reservoir. Reinforced concrete pipes are to be used because there is less danger of incrustation in them than in cast iron pipes. The expenditure was sanctioned under the Acts of 1914 and 1920.

ACCORDING to the *Indian Importer and Bazaar Trades Journal*, the first issue of which has just been published, a plan is being considered for the construction of plant on the Western Coast of India to produce, from bauxite, about 2500 tons of aluminium a year, by the use of electricity. Considerable quantities of aluminium for the manufacture of cooking and other utensils are imported, and it is thought there will be a good market for the product and a demand for any surplus power.

ACCORDING to the *Architect*, the Ayr Corporation proposes to seek parliamentary powers for obtaining water power at Loch Doon for the supply of electric current for the district. The scheme is estimated to cost £250,000. The existing works are not adequate to the needs of the town, and are not conveniently situated for extension. A report on the scheme has been obtained from Mr. Rider, consulting engineer, London, who states that he is of the opinion that "the scheme is of such a promising character, and involves such a small amount of engineering works, that it should be put in hand at the earliest possible moment."

WE understand that the Society of Technical Engineers has now, after more than three years' preliminary work, been able to settle its general policy. A series of general meetings of the branches of the Society throughout the country showed a most remarkable degree of unanimity in regard to this matter, especially since the membership includes technical engineers from many departments of engineering and men of very varied standing from junior assistants to heads of departments. The Society only awaits now the final settlement, by the Executive, of the actual terms in which a statement of the policy is to be published. This settlement, it is hoped, will be effected in the course of the next two or three weeks.

THE report of a Committee on Research Work in the Colonies, appointed to consider what steps could be taken to secure the assistance of the universities of this country in carrying out research work essential to the protection of the inhabitants of the Colonies and Protectorates from disease, and to the successful development of their veterinary, agricultural, and mineral resources, was issued on Tuesday, August 23rd. The Committee has reached the conclusion that, for the recruiting of scientific departments in the Colonies, the universities and allied institutions in this country can most usefully and directly assist by encouraging post-graduate study, and by providing facilities in their laboratories for the training of students in the principles and methods of independent research.

A STORY told in one of the Lorraine journals is to the effect that the railway administration of the restored provinces required six large boring machines of a type that was supplied before the war by a firm in Mannheim. An inquiry to that firm elicited a quotation of 60,000f. for each machine. It was, however, decided that under no circumstances could anything be purchased in Germany for the Alsace-Lorraine railways, and tenders were accordingly invited from Allied countries. The only one received was from England of 200,000f. for each machine. Despite the great difference in price the order was given to the English firm, and the machines were delivered in due course, with instructions that they were not to be erected before the arrival of men who were being sent out for the purpose. At the Bischeim depôt in Alsace the boring machine delivered there was so urgently needed that no account was taken of the instruction, and when the machine was unpacked the name of the maker was startlingly visible—that of the firm in Mannheim.

A BIRMINGHAM SWITCHGEAR WORKS

(*For description see page 238*)

FIG. 9—PART OF ASSEMBLY DEPARTMENT

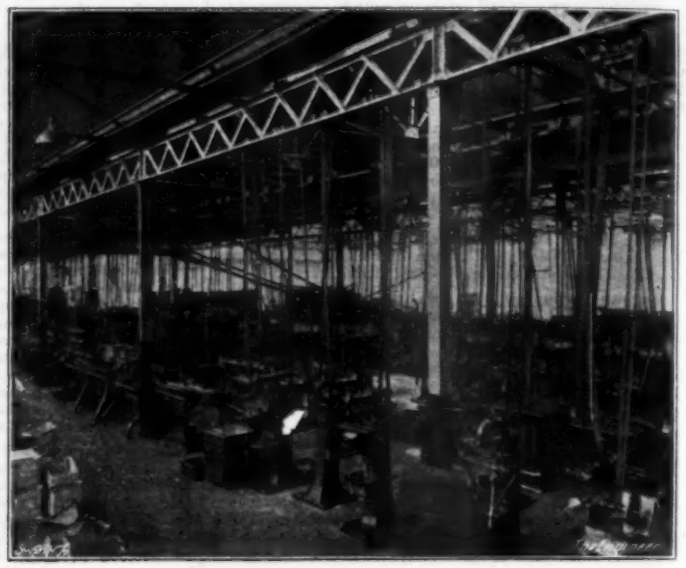


FIG. 10—PART OF MACHINE SHOP

FIG. 11—PART OF MACHINE SHOP

FIG. 12—TOOL ROOM

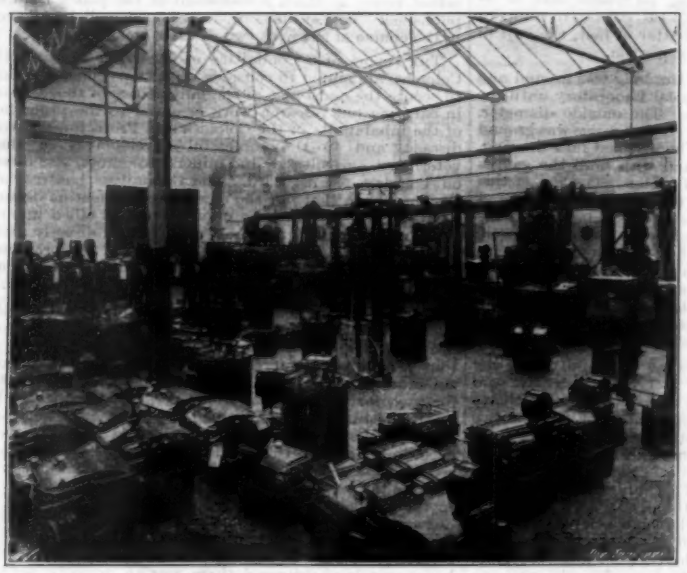


FIG. 13—TESTING DEPARTMENT

FIG. 14—STOCK ROOM

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SOUTH AMERICAN BRANCH OFFICE OF

The Engineer.

526, Bolsa de Comercio, Buenos Aires.

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THE ENGINEER can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.

Half-yearly (including index number) .. £1 12s. 6d.
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SEPTEMBER 2, 1921.

Engineering Design and the Public.

IT is inevitable, after any disaster or accident that stirs the public mind and imagination, that there should be much greatly misinformed criticism and comment, both written and spoken, and many expressions of opinion that are clearly based on a very partial acquaintance with physical and scientific facts and technical practice. The quack doctor with his quack remedies is a less intrusive person than the amateur engineer, and in some respects is more easily dealt with, for while most people profess considerable ignorance of medicine, few are willing to admit that they know nothing about engineering. The war undoubtedly made many people acquainted with some aspects of engineering or with the results of some branch of engineering activity of which otherwise they would have remained very largely and possibly wholly in ignorance. We are not especially referring to the women who became machine attendants in munition works. Rather are we speaking of those who passed through the ranks of the Royal Engineers, the Tank Corps, the Mechanical Transport section, the Air Force, the gardeners, chauffeurs and cabinet makers who became inspectors of war-time engineering products, and all those others who, whether at home or abroad, were forced into intimate daily contact with things mechanical. Not for one moment would we seek to disparage their work or to suggest that fully qualified and properly trained engineers could have done it more effectively than they. The opinion, however, may—we hope without giving offence in any quarter—be expressed that many are still inclined to regard their war-time mechanical experiences as qualifying them in some measure to act or speak as engineers. In reality the vast majority saw a very restricted portion of the engineer's art, and, moreover, were brought into contact with it at a time when it was being directed towards one particular end—the winning of the war—and when it was, in not a few respects, forcibly reduced to a lower standard than that commonly insisted upon in peace time. If, without risking our own happiness and peace of mind, we may venture to do so, we would like to remind those concerned that engineering is still a highly technical profession, and that in spite of all the simplification of design and manufacturing processes introduced during and since the war, its proper understanding is certainly not becoming easier even for engineers, let alone the general public.

Up to a certain point we rejoice to see the spread of familiarity with the results and products of engineering among those whose interests do not strictly lie within the profession. In this mechanical age it is clearly desirable that all should have a certain amount of mechanical knowledge. Nevertheless, the more mechanical our civilisation and daily life become the more essential is it to leave the final control and judgment on all mechanical matters in the hands of fully trained technical engineers. In days gone by many mechanical inventions and improvements of great value and importance were first proposed or brought to fruition by men who were not engineers—at least by profession. Knowing this fact, many non-technical people to-day still think that the outsider must be able to see most of the game and that the opportunity is still open to them to rival the historic achievements of Arkwright, Corliss, Lee, Fulton, Armstrong, and all the other pioneers of engineering who were not engineers by common designation. The truth is that engineering has long since passed its childhood, and that the influence which non-engineers in the past exerted on mechanical invention and progress was only possible because engineering as yet was not a clearly marked profession engaging the exclusive attention of specialists. We are not prepared to say that no more ideas of technical value will be received from outsiders, for it is always possible that the intelligence and experience now concentrated in the ranks of professional engineers may have overlooked some fact, some means of improvement, or some possibility of effecting a desired but hitherto unattained result. Nevertheless, recalling the outstanding mechanical inventions of the immediate past—the motor car, the submarine, the aeroplane, the turbine and the Diesel engine—it must be admitted that professional engineers have no need to be ashamed of the share they have taken in the advancement of mechanical science. That outsiders have still a chance to take part in the march of mechanical progress need not be denied, but that it is an exceedingly poor chance must be evident to all who know the real position. Yet not for one moment do we expect any diminution in the correspondence we receive from would-be inventors who, in nine cases out of ten—almost, it would seem, as a recommendation—proclaim to us the fact that they are not engineers. Nor do we hope for any reduction in the tide of ill-informed criticism and suggestion which these same people and their like will shower upon our attention when any striking disaster, accident or other happening calls public attention to the shortcomings and imperfections of modern mechanical science and its achievements. Rather do we look for an increase in the number of non-technical inventors and critics, for, as we remarked at the outset, the war experiences of many people qualify them, in their own view, to pose in some respects as engineers.

The daily Press is responsible for a good measure of the desirable spread of general mechanical knowledge. It is not, however, free from blame in the matter of encouraging the public to take a false view of engineering progress. We deplore the importation of journalistic sensationalism into the quiet fields of scientific and technical discovery and progress. Engineering is still very far indeed from being an exact and perfect science, and when the expected revolution of some department of our lives—heralded with brazen trumpets and leaded type—fails to become effective, the public is disappointed and misled. Still worse when the boasted triumph ends in pitiable disaster, the public becomes highly critical and loses faith in the engineer. Can any engineer surveying last week's airship tragedy and the comments which it called forth doubt for one moment the unwisdom of encouraging the public unnecessarily to study engineering design and to set up as critics of it? To some people certain of the remarks published on the supposed cause of the disaster must have come as a shock in that they revealed for the first time the fact that engineers are not omniscient, and that they use things called factors of safety to cover their ignorance. Our ignorance of the stresses in the framework of an airship and of the strength of its parts is no greater than in the case of a railway bridge, the hull of a steamship or the axle of a motor car. The Press reports and criticism of the disaster doubtlessly alarmed the public as to the extent to which guess-work still enters into engineering design. Yet, were it only known, the same element of guess-work—with, however, the saving grace of long experience—is present in the design of all vital engineering works which the public uses without discomposure. It is essential to preserve the faith of the people in the engineer and his works. At every turn in modern life they are brought into vital contact with his art, and were their faith in his ability completely or only partially destroyed, disorganisation and even panic would ensue. Engineers are well aware of the deficiencies of their knowledge and attainments. They do not seek to hide them. But just as greatly as they desire that the public should not be led to expect miracles, so, too, do they plead that public discussion of their fallibility should, in the interests of the public itself, be intelligently restrained. In this matter the profession is exactly on the terms of a doctor with

his patient. Faith in the doctor's knowledge effects half the cure, and must be developed by all means, even by artifice if necessary. The public of to-day has no choice but to submit its health, happiness and life itself to the engineer. Let us take every care to see that the trust reposed in us is not shaken or destroyed by ill-considered, partially informed and wholly dangerous outside criticism.

Employers and Employed.

THE settlement of the miners' strike, the fact that the output of coal is steadily increasing week by week, that iron furnaces are being put into blast, and that many works which had reached the stage of suspended animation are again coming to life, have raised hopes that the industrial situation is on the mend. The return of the men to the pits was only one of the signs which have been given that the labour element in industry is beginning to see reason and to grasp the elementary economic truths which at any time, but particularly to-day, dominate the industrial and commercial situation. There is in some quarters a disposition in face of the demonstration that high nominal rates of wages are associated with abnormally high rates of unemployment to look at the problem from a wider standpoint. The workers, taught by unpleasant experience, are beginning to grasp the fact that rates of wages, or rather the ratio of wages to total costs of production, are really governed, not by arrangements made between employers and employed in this or any other country, but by conditions in all producing countries, and that unduly high rates of wages, associated as they have been in the United Kingdom with low production, are a grave disadvantage to workers as well as to employers. It will take time for this elementary truth to be generally accepted; the light is only spreading slowly, and there are still many branches of industry into which it has not yet penetrated. The shipyard joiners' strike provided an example of the lengths to which some bodies of workers will go in an endeavour to resist the cutting off of war bonuses for which, even at the time when they were first granted, there was little or no justification. In other quarters, too, there is a disposition to haggle over new arrangements which are quite inevitable. Nominally the whole of the bonuses granted by complacent Government departments during their control of the industrial activities of the nation come to an end on September 1st, and the moment is therefore opportune to discuss the whole plan on which the payment of the wage-earning classes is based.

There are many who will be disposed to agree with the contention that modern trade unionism, and indeed the employers' organisations by which the unions are confronted, have both failed to achieve their objects. Signs that these bodies have outlived their period of usefulness are beginning to multiply. One of their chief defects is that in their present form they are too unwieldy. It is impossible that we can ever revive the days of the small business in which the employer was intimately acquainted with all his workpeople and maintained personal relations with every member of his staff. Under such conditions the employer was able to deal with individual grievances, and the wages questions which arose only affected comparatively small numbers and could be adjusted without interference from outside. Having deliberately elected to replace this system by one in which employers and employed confront each other from great hostile camps, it is necessary either to see that this plan gives the desired results or to replace it by a new one. It cannot be pretended even by the most ardent advocate of the existing machinery for settling trade disputes that it has not broken down badly during the past few years. The truth is that organisations like the Amalgamated Engineering Union and its allies are too large to do effective work. The executive, from the very nature of things, is out of touch with the rank and file, and the interests which have been grouped in recent amalgamations of trade unions are too diverse to be adequately represented by a single executive or negotiating committee. No surprise need be felt in such circumstances that decisions arrived at by an executive and recommended for acceptance by its members are repudiated. The explanation is that the attempt to bring all workers into vast unions for the purpose of taking common action, which it was imagined would be a source of strength, is proving a weakness for the reason that the executives cannot control the huge armies which they have been appointed to command. There is mutiny in the ranks, and the discontent with the leaders has in many instances reached a point at which they know that agreements made by them on behalf of the unions will be subjected to a hostile vote. The same is true in a lesser degree of the employers' organisations. They also are too large, although it cannot be said that any arrangement made with trade union representatives by employers' leaders has ever been repudiated by any of the firms affiliated to such bodies as the Engineering Employers' Federation or the similar Federation of Shipbuilding Employers. The long-drawn-out conferences which have been held at various times during the past year and the failure in some instances to arrive at any agreement on the points at issue after an inordinate expenditure of time, give proof that the method of dealing with questions affecting employers and employed through amalgamated trade unions and federations does not meet the needs of the time. An illustration of the danger of attempting to deal with these subjects on wholesale lines is to be found in the railway wages situation. The standardisation of wages and hours of working on the railways has led to the absurd situation of men employed on the lightest duties in remote country districts, where the cost of living is lower, being paid the same wages and working the same number of hours as men engaged on the same class of work in intensely congested railway areas. Nothing could demonstrate in a more striking manner the futility of attempting to reduce the value of the labour of large bodies of men engaged in the same industry, but in different branches of it, to the same common denominator. Yet if the railways provide the outstanding example of the lengths to which this principle may be carried it will be agreed that something of the same kind has taken place in the engineering trades. For the sake of attaining uniformity of wages and working conditions men employed in arduous occupations carried on in an unpleasant environment are compelled to toil weekly for the same number of hours as those engaged in comparatively light tasks in moderately comfortable if not congenial surroundings. Those who have made any study of the subject of industrial fatigue know the varying effects on the individual of various kinds of employment and the environment in which the work is performed.

It would seem that what is required, if British industry is to be adjusted, as it must be, to the new conditions of the post-war period, is that the whole subject of wages and hours and conditions of working should be studied from a new angle. In the long run the principle of payment by results, in spite of all efforts to evade it, must persist. We believe, too, that the wise plan, if workers would agree to it, would be to meet the growing menace of foreign competition—which demands that production costs should be reduced—partly by a reduction of nominal rates of wages and partly by lengthening the working week. It is a plan which is being tested here and there with good results. It need not necessarily reduce the actual earnings of the men to a level which would be inconsistent with the cost of living, the fall in which, it is admitted, by reason of exceptional circumstances, has been momentarily at least arrested. There could be no simpler remedy for the difficulties under which British industry is labouring than a moderate lengthening of the working week. We suggest that any change of this description might be associated with the allocation of a definite percentage of profits to a fund which would be used to distribute dividends to workers, care being taken to ensure that the profit-sharing arrangements were such as to give the worker a real interest in the business. The fundamental defect of a majority of these schemes is that they offer too remote a chance of gain to a class which is accustomed to reckon its earnings by the contents of the weekly pay envelope. What is wanted, in a word, in this, as in other matters affecting the welfare of the wage-earning class, is a return in some measure to the personal touch and the human relationships which modern trades unionism, and the great increase in the size of firms, have done so much to exterminate. We believe that the time is opportune for achieving something on the lines suggested. It is obvious that a practically new industrial system must be created; let us see to it that the foundations are well and truly laid.

A Lesson from Past Experience.

THE disaster to airship R 38—or ZR 2, under her United States title—accompanied by all the distressing consequences which accidents of such a nature unfortunately inevitably entail, called primarily for a profound expression of sympathy with the relatives of the Anglo-American crew who lost their lives while on duty in what is, undoubtedly, a hazardous occupation. An accident affecting our own Air Service alone is always sufficiently pathetic; this one is rendered the more regrettable by the fatalities amongst the officers and men of the United States Air Service, who, as students and welcome guests of the Royal Air Service, were co-operating with our own men on board R 38 preparatory to flying the ship over to the United States. On all sides, too, sympathy will be extended to the Royal Air Service. It has had a difficult and uphill fight ever since its inception, and at the present juncture, particularly, needs all the support which it very justly deserves. It cannot be denied, unfortunately, that aviation contains particular elements of risk, though these are being gradually eliminated, and it is not too much to hope that this disaster will go a long way in causing their reduction still further. The early years of aeroplane development, particularly between 1909 and 1912, witnessed a long and unhappy list of casualties from which we have latterly been singularly free, but airship construction, though it has not added a corresponding list of fatalities, has always been remarkable for the consistent destruction of material which has taken place. Delicate, unwieldy and very hard to handle, nearly all the large airships built between 1905 and 1912—numbering about thirty—came to grief, but luckily in most cases these accidents occurred on the ground, at moorings or in hangars, without loss of life, and, in all, the number of deaths involved did not reach the unhappy total occasioned in this last accident alone. Up to 1914 at least ten German airships, of which seven or eight were Zeppelins, seven British, five French and four American ships were wrecked from various causes, such as being blown from their moorings or damaged by storm—which were the commonest causes—damaged in landing, accidents in hangars, fire (three cases), and bursting in the air (two American cases), &c. The worst accident since the Armistice was to the British naval airship NS 2, which was struck by lighting while in the air in July, 1919, nine lives being lost. Damage arising from causes other than enemy action was fairly frequent during the war, several modern Zeppelins being rendered useless or being destroyed through damage by storm, accidents in landing or by fire. More recently, without loss of life to call attention to the destruction of material, we have witnessed the accident to R 34, which collided with a hill during a fog in January last and became a total wreck. The whole record of airship construction under peace conditions is one of disaster, arising practically entirely out of their extreme fragility and their small weight in proportion to their colossal bulk, rendering them extremely difficult to handle. Their war utility, particularly for naval scouting, proved indisputable; for actual fighting they were of little use compared to the aeroplane, and were shot down with comparative ease—some forty being destroyed in the course of the war. Roughly speaking, about one hundred large airships, the latest costing perhaps half a million pounds, have been constructed in the last fifteen years; there are probably not half a dozen fit to fly to-day. Much as we deplore the loss of life, for the material is more or less readily replaceable—at huge expense!—it is to be feared that in the development of aerial transport such an accident was sooner or later practically inevitable. It is too much to expect that it will be the last, but the sacrifice is one that carries with it a very cogent lesson and that not without ample precedent.

Prior to any finding of the court of inquiry which is being held, it is premature to suggest a precise cause of the disaster. Survivors have stated that they believed they heard girders breaking, and there is apparently no doubt that either structural weakness or explosion was the reason, the latter possibly supervening on the former, as any displacement of the petrol tanks might so easily encourage one. We may, however, without any impropriety, refer to two trenchant parallel cases. Just ten years ago, naval airship No. 1, which had been built at Barrow-in-Furness, was being taken out of the erecting shed for her first trial, when she broke amidships, the structure sheering transversely with apparently a minimum of effort. It is true that the vessel had remained in the air for over thirty hours at her mooring in the Barrow dock a short time before, but it is difficult to persuade engineers that her failure was unconnected with inadequate structural strength. But from whatever cause airship No. 1 failed, there is another case just twenty years' old, almost to a day, which is in danger of being forgotten, in which also some fifty men lost their lives on account of structural weakness, and this episode received such careful attention at the time that no further trouble on this score has since been occasioned. We refer to the loss of H.M. torpedo-boat destroyer Cobra on September 18th, 1901. The lesson learnt from that disaster is particularly applicable to the present case. The inquiry into the cause of the vessel's loss was properly conducted with very scrupulous care and investigation. Practical experiment on a previously unheard of scale was promptly undertaken in conjunction with a really scientific mathematical investigation into the strength of hulls, and the whole searching inquiry into the subject formed both a model of procedure as to the manner in which it was conducted, and established our knowledge of the strains encountered in ships' hulls on a basis that has proved pre-eminently satisfactory. The confirmation and checking of strains experienced on a full-size structure with those derived from calculation was carried out in a way that deserves to be recalled at the present juncture in some detail.

H.M.S. Cobra was laid down by Sir W. G. Arm-

strong, Whitworth and Co., Limited, at Elswick in 1898, and launched in the following year. The firm had had the intention of building an experimental vessel for testing the Parsons marine turbine for some time, and had got out designs in 1895 and 1896 for this purpose, but it was not until later that it was enabled to do so. The possibility of eventually disposing of the vessel to the Government was borne in mind, and the ship was constructed in every way as if she were being built under Admiralty supervision. The vessel was of similar dimensions to the 30-knot destroyers then under construction. Her length was 223ft. 6in., beam 20ft. 6in., depth 13ft. 6in. and the displacement was 350 tons on 5ft. 6in. draught. The full load displacement was about 490 tons, this including about 110 tons of coal. She was fitted with Parsons marine turbines, driving four shafts, and attained a speed of 34.8 knots on preliminary trials. She was offered to the Admiralty in December, 1899, and after certain structural modifications insisted on by the Government was finally accepted in 1900. About this period, destroyers of this size were being built in large numbers for both British and foreign Governments, and their light scantlings had given no cause for uneasiness, in spite of voyages to all parts of the world, though there had undoubtedly been several cases of weakness displayed. The most remarkable of these was in April, 1901, when H.M.S. Seal was struck by an enormous wave in the Bristol Channel. Her upper deck was cracked right across, admitting daylight to the stokehold, and the side plating was split for 18in. down from the deck. This was a very exceptional case, and nothing but able seamanship saved the vessel, which returned to port with a wire hawser stretched from round the conning-tower into the engine-room skylights and tightened up with stretching screws, in order to take the strain off the deck between these two points.

The usual calculations for strength were made in the case of the Cobra. The static stresses experienced in hogging and sagging condition when the vessel was assumed to be poised on the crest or in the trough of a trochoidal wave of height equal to one-twentieth of the length were worked out, and it was estimated that under these conditions the greatest stress would not exceed 9 tons per square inch. Mild steel of 28–30 tons tensile strength, with an elastic limit of 14 to 15 tons, was employed in the construction. Compared with other destroyers of the same period, the calculated stress allowed was undoubtedly on the high side. Prior to being handed over to the Admiralty, the Cobra had made some dozen short speed trials off the Tyne. The structural modifications which she underwent at Elswick before delivery consisted in stiffening the deck amidships, the keel members being left untouched. She left the Tyne to proceed to Chatham to undergo official trials, being loaded to a displacement of 468 tons, or practically full-load conditions. She ran into rough weather off the Lincolnshire coast, and, finally, off the Outer Dowsing shoal, broke her keel while plunging in a heavy sea and sank with considerable loss of life. The court martial selected to try the survivors stated in its verdict that the vessel did not touch the ground nor meet with any obstruction, but that the disaster was due to structural weakness of the ship. The depth of water—80ft.—precluded any idea of striking sunken wreckage. Divers who inspected the broken hull reported that the vessel had broken between the two after boilers in the after stokehold, and that the break occurred between two frames across a plate and not through a line of rivet holes. A certain amount of mystery and feeling was created over the evidence obtained from the wreck, and it is not our desire to revive a controversy so much as to emphasise, with reference to the breaking up of R 38, the method in which the destroyer problem was tackled, and how it has resulted.

After the report of the court martial, an Admiralty Committee was formed, under the presidency of the late Admiral Fitzgerald, aided by Sir John Biles and a staff which he selected for mathematical work, to investigate the whole problem of hull stresses in these light craft. It was not a simple one; its investigation at all, on any satisfactory basis, went directly to the root of the whole principle of steel ship design—that is, to the ascertainment of the extent to which theoretical calculations of hull strength indicated stresses in accordance with those actually encountered. Shipbuilders and owners alike owe a good deal to the Admiralty and the Royal Corps of Naval Constructors. Most of the really classic papers on design have emanated from sources controlled by the Admiralty, but their investigation into the strength of hulls is one of the best examples extant of such work well done. Theory and practical experiment were combined to check whether the usual system of calculation of strength was approximately correct, and for this purpose H.M. torpedo-boat destroyer Wolf was selected. She was a sister ship of the Seal, which had already suffered damage in a heavy sea—not on account of actual weakness, be it remarked, but on account of the exceptional weather to which she was exposed.

The Wolf was subjected to some remarkable tests in Portsmouth Dockyard, and a full account of them was published by Sir John Biles in the "Transactions" of the Institution of Naval Architects for 1905. At the same time, a very full series of paper calculations was made and published for public benefit. The experiments on the Wolf were directed to determining:—(*a*) The strains which known bending moments produced in the structure; (*b*) the stresses corresponding to those strains; and (*c*) a calibration of the structure in relation to definite known bending moments; so that when the vessel at sea became subjected to an unknown bending moment which produced observable and measurable strains in the calibrated parts, the actual bending moments could be inferred from these indications. The Wolf's plating amidships was 10 lb. in keel, sheer strake and deck stringer, 8 lb. in the garboard strake, and 7 lb. elsewhere.

Without detailing the many important items which required extreme care in order to arrive at a proper determination of the strains and stresses, the experiment generally was as follows:—

The vessel was supported in two cradles, each 6ft. long, situated under the two engine-room bulkheads—the Wolf's engine-room was amidships, between the two boiler-rooms—the centres being 26ft. apart. For this experiment on hogging strains, the vessel was empty as regards water in boilers and coal bunkers, but otherwise in commissioned condition—*i.e.*, guns, torpedo tubes, &c., on board. Stromeyer's strain indicators were placed at numerous points of the ship's structure to register the necessary information. The vessel was allowed to sink on to these cradles in dock, and when the weight was taken on them, the water was gradually run out of the dock, the level being reduced 6in. at a time, until eventually the dock was empty and the vessel left hanging for about two hours unsupported except by these cradles. Readings were taken for each reduction, and this entire process was repeated several times until adequate data were secured. The vessel was then floated, the position of the cradles was altered to 120ft. centres, boilers and bunkers were filled till the vessel was at a displacement of 423 tons, and the whole process was repeated to obtain the stresses in sagging condition. The pessimists who predicted disaster proved wrong. The Wolf withstood all tests—and they were a serious strain to bring on any vessel—with brilliant success. She was 210ft. long and 12ft. 6in. deep, so that for hogging condition there was an unsupported length of 90ft. at each end. None the worse for this drastic experience, the vessel was then taken to sea, in accordance with the determination of actual stresses under (*c*) above. The commanding officer was instructed to seek for the worst seas he could find, and observers were told off to watch the strain indicators under those conditions. The results are of extreme interest. The theoretical maximum stresses when the vessel was poised on a standard wave were 7.14 tons per square inch tension on the keel and 5.3 tons per square inch compression on the deck. The greatest recorded stresses when the vessel was in the dry dock were 6.4 and 5.5 respectively, the latter measurement being on the side stringers. On the middle plating of the deck it was 7.0 tons, the plating there being 5 lb. plating; on the sheer strake 4.4 tons. When the vessel was steaming at 13 knots in very heavy weather off the Lizard, the maximum recorded stresses were 5.4 tons on the keel and 2.5 tons on the deck. It will be seen therefore that the vessel successfully withstood in dock far greater stresses than the worst actually encountered at sea, and further, that the method of calculation employed in assuming the vessel to be poised on a standard wave overrates the real stress.

Longitudinal bending stresses are by no means the only ones to which a hull is subjected. When turning at full speed, some very extraordinary and abnormal stresses are involved, and calculations based on standard waves of trochoidal form, excellent as they may be for comparative purposes, are, after all, calculations of the purely static condition; they take no account of the inertia of the ends as the vessel pitches in a seaway. More than one of the early destroyers lost its rudder on full speed circling trials, the pintle holding it being quite insufficient to withstand the strain. Certainly one, a foreign destroyer constructed by a well-known builder, had the misfortune to rend the side plating amidships when turned at full speed, and on various occasions motor boats have actually capsized when turning at full speed, owing to the centrifugal action acting through the C.G. entirely overcoming the stability offered by the water-line plane and the resistance of the rudder. These are very exceptional cases, but they are quoted as extremes of what ships may encounter. Very long and varied experience has taught shipbuilders a sense of proportion, apart from all calculation. The net result in practice of the Wolf experiments, in spite of the successful way in which the strains were withstood, was a strengthening of hulls, and though at least twice during the war an accident similar to that encountered by H.M.S. Seal was occasioned, no loss of ship has arisen from the same cause as that which proved fatal to the Cobra.

Now, the whole question of the structural strength of airships is very different from that of surface ships. The complexities encountered in the latter are sheer simplicity to those met with in the former, and, moreover, we are not dealing with steel, but with a material of which we know comparatively little. When the May-fly broke at Barrow, rigid airship construction was suspended in England until a German machine was shot down five years later. There was no past practice on which to base any calculation at all, and an airship is a diabolically complex proposition. There is an amazing difference between the inflated and the empty condition as regards the shearing stresses encountered. "Rigid," as applied to an airship, is a mere term; the deflections in a battle-cruiser 700ft. long introduce sufficient difficulties when it comes to boring out the shaft tubes. What the deflections of a "rigid" airship may be are not known. Steel, we know, will withstand them. What is our real experience of duralumin for structural purposes under continually fluctuating stress? In the destroyers it was found that the greatest care was necessary in dealing with 5 lb., 7 lb. and 10 lb. steel plating to ensure that each member was taking its proper share of the load. The average angle bar was perhaps 2½in. by 2½in. by ½in. A fraction more or less in the rolling would hardly affect the moment of inertia of the section. But in an airship, with scantlings for main members, say, 1½in. by 1½in. by $^1/_{16}$in., a very small error in rolling makes a very big difference. It may be quite small in actual amount, but it may introduce a local weakness whereon a concentrated stress may work all manner of evil. The longitudinal construction of airships is somewhat similar to an "Isherwood" hull. There are about twenty-five longitudinal members round the circumference—perhaps more. Then there are ring girders connecting these at about 15ft. to 20ft. intervals, like the frames of a ship, and each alternate one constitutes a main transverse frame, rather like a bulkhead. These latter are wired into a centre, like the spokes of a bicycle wheel. Each panel between the longitudinals and the ring girders is diagonally wired. No brief description can convey the slightest idea of the innumerable problems in shearing force and bending moments that such a construction implies. Into this colossal and flimsy web a series of buoyancy chambers is introduced. Stuck on to the extreme end are huge rudders and fins for steering and elevating. Every time these are operated, the huge main fabric is stressed—how much no one knows. There are perhaps half a dozen very able men in the country with experience of these structures. Mr. C. I. R. Campbell, of the R.C.N.C., the Superintendent of the Royal Airship Works, was unfortunately killed in R 38, so that his invaluable experience is lost to the country. Experiments were in progress on the subject of strains on rudders and fins when the disaster occurred, and the information apparently is lost also.

It is difficult to imagine that the technical difficulties involved in design will constitute any bar to airship development. At the moment, the question of finance would seem to be the greatest hindrance. The check to progress which the disaster to R 38 seems likely to create is one that calls for energetic treatment, and is not a position to be quietly accepted. The visions of Transatlantic or Australasian air services which the Imperial Conference conjured up have vanished for the time being. Nebulous as was the idea, this disaster has clearly shown that until very considerably more is learnt about the construction of these large light structures, any commercial service is absolutely out of the question. R 34 made a successful Transatlantic trip, which at the present time is on a par with Captain Webb's feat in swimming the Channel. It showed that it can be done, but it has never been repeated. It would appear that we have now a really excellent opportunity of profiting by our experience. We still have two or three airships—R 33, a sister to the Transatlantic machine; and R 80, which is of much better stream-line form, but rather smaller; L 71, of German manufacture, is also available. There is not the slightest likelihood of a purchaser being forthcoming for these craft, and, not to put too fine a point upon it, they are not far removed from scrap. Costly and useless for purposes of pure aviation, they do undoubtedly offer a magnificent opportunity for structural tests on a large scale. The Admiralty set a splendid example after the Cobra disaster, and, if any development is to be made in lighter-than-air aviation, now is the time. The appointment of a committee to investigate the stresses theoretically, supplemented by experiments on R 33 or R 80 after the nature of those conducted on the Wolf, might just save the Royal Air Service and the nation from relapsing into that state of lethargic apathy toward airship development into which it fell ten years ago after the accident to the May-fly. We do not know whether strain indicators were fitted to R 38 or not, but they are essential for a proper investigation of the subject. Our suggestion is that a thorough loading test, both empty and inflated, be made on at least one of our existing airships, in association with both a theoretical investigation and tests in flight on similar lines to those followed in the case of the Cobra Committee. The expense will not be great; the opportunity is excellent, and it is entirely immaterial whether the structure fails under load in the hangars or not, for confidence in existing designs and material has received a very severe shock, and it is far better that one hull should be broken under test than another be allowed to collapse in the air. The success which followed the results of the trials with the Wolf amply repaid the trouble and expense. If our existing airships are scrapped without such a trial, we shall indeed have wasted time and opportunity.

ELECTRICALLY OPERATED BATTERY OF DROP HAMMERS

BRETT'S PATENT LIFTER COMPANY, LIMITED, COVENTRY, ENGINEERS

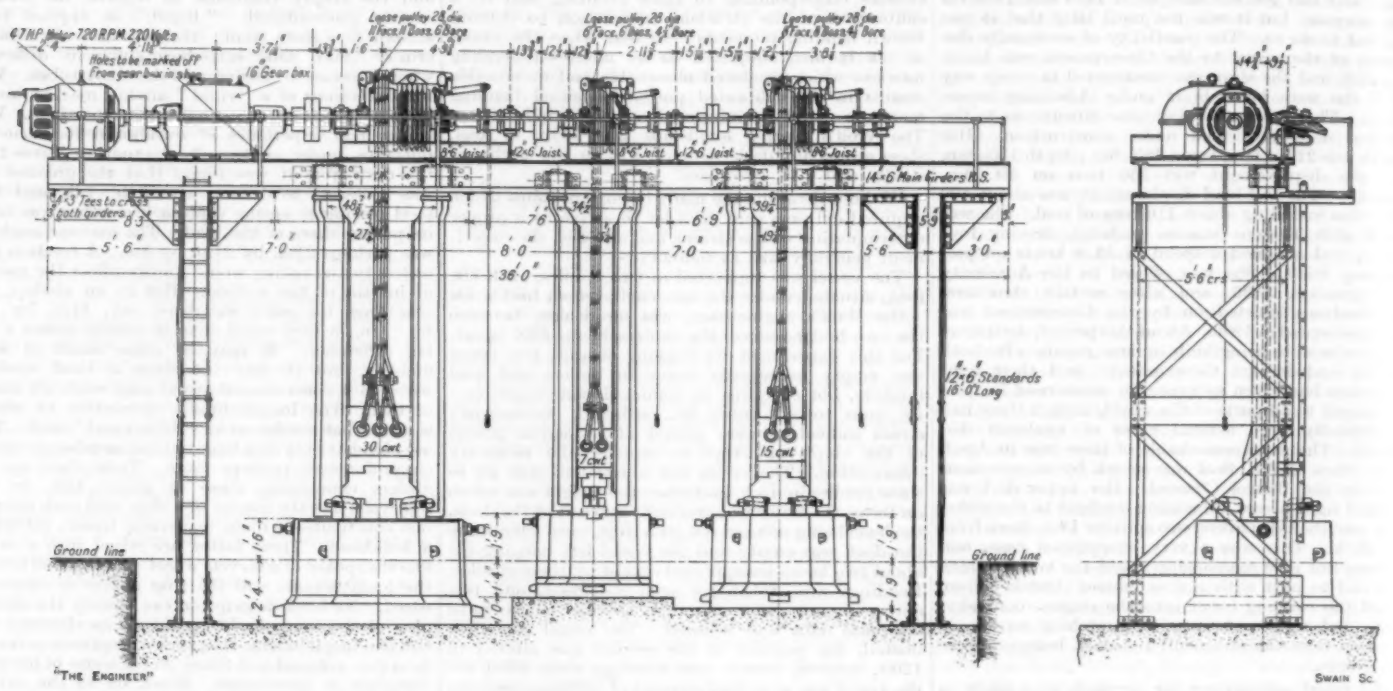

67 HP. Motor 720 R.P.M. 220 Volts
Holes to be marked off From gear box in above
16" Gear box
Loose pulley 28" dia. 11" face, 8" bore, 6 Bore
Loose pulley 28 dia 6" face, 6" bore, 4½" Bore
Loose pulley 28" dia. 11" face, 8" bore, 4½ Bore
9" Joist
12×6 Joist
14×6 Main Girders N.S.
4"×3" Tees to cross 3 goth girders
12×6 Standards 16'0" Long
30 cwt.
7 cwt.
15 cwt.
Ground line
5'6" crs
"THE ENGINEER"
SWAIN Sc.

FIG. 1

A Drop-Hammer Battery for China.

An electrically driven battery of three drop hammers has recently been completed to the order of J. Whittall and Co., Limited, by Brett's Patent Lifter Company, Limited, of Coventry. The battery, which is shown in Fig. 1, consists of a 30 cwt. and a 15 cwt. hammer for die work, with a 7 cwt. hammer, placed in between, fitted with roughing out or forming tools to act as a dummying hammer for the two larger sizes. It is intended for use in the engineering shops of the Pekin-Mukden Railway.

As will be seen from Fig. 2, which shows the actuating mechanism of the hammers, the three lifters are mounted on a common shaft, which is built up in three sections with steel couplings, and is driven through double-reduction gearing, which is enclosed in an oil bath, an electric motor providing the motive power. The connection between the motor and gear-box takes the form of a centrifugal expanding coupling which permits of the motor being started up light, and of the power being gradually transferred as the speed increases. The makers point out that there are many advantages of such form of drive over the usual belt method. In the first place, the motor occupies no ground space, which is a considerable advantage in a stamp shop. Then there is no belt to be watched and kept tight, and, furthermore, that the wear on the bearings of the motor on the direct drive must be considerably more even than it is when the connection is by belt on to a fly-wheel. The gear wheels have machine-cut double helical wheels which run in an oil bath, and they were working with practically no noise at all when we saw the plant in operation. The enclosed gear-box has, of course, many advantages over open gears, especially when they have to work on a gantry which, under the load of the lifting hammers invariably springs, with the result that an even meshing effect is practically impossible.

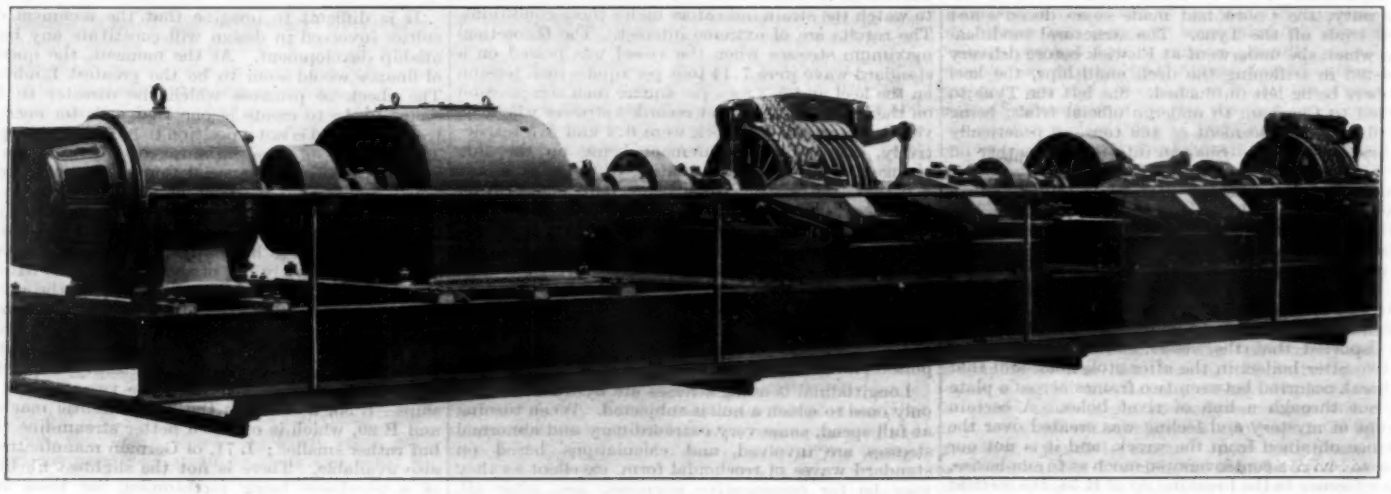


FIG. 2—GANTRY AND HAMMER-OPERATING MECHANISMS

The lifter now employed by Messrs. Brett is an improvement of the mechanism which was formerly used and which we have described in previous issues. The arrangement now adopted is shown in Fig. 4. It will be seen that the appliance is actually very simple. The working of it is as follows:—The steel grooved drum B is firmly keyed on to the shaft J, and rotates continuously with it. The pulley I at the side is loose on the shaft, and the rope connected to the shoulder C^1 of the shackle C and which supports the hammer tup rests on this pulley in the ordinary way. The two lifting levers A, A^1 are also loose on the shaft, and are bushed with phosphor-bronze. They are connected at the top by the shackle C, which is pivoted on the left-hand side to the top of A, but is free to move up and down in the slot at the top of the right-hand lever A^1. The friction blocks D, D are suspended from the shackle, and when the latter is pulled downwards it causes the friction blocks to engage with corresponding grooves in the steel drum. The number of grooves depends on the weight of the tup. The 30 cwt. hammer has six, the

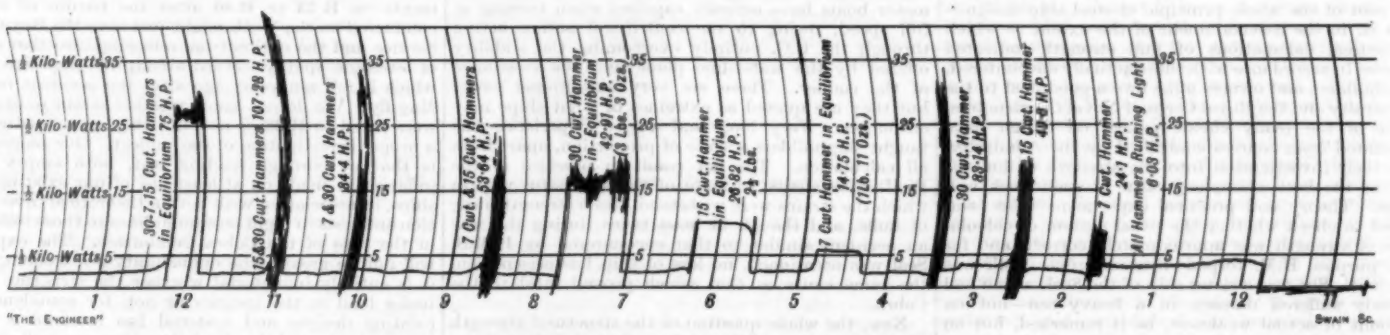

½ Kilo-Watts 35
½ Kilo-Watts 25
½ Kilo-Watts 15
½ Kilo-Watts 5
30-7-15 Cwt. Hammers in Equilibrium 75 H.P.
15 & 30 Cwt. Hammers 107·26 H.P.
7 & 30 Cwt. Hammers 84·4 H.P.
7 Cwt. & 15 Cwt. Hammers 53·64 H.P.
30 Cwt. Hammer in Equilibrium 43·91 H.P. 13 Lbs. 3 Ozs.
15 Cwt. Hammer in Equilibrium 26·52 H.P. 2¼ Lbs.
7 Cwt. Hammer in Equilibrium 14·75 H.P. (1 Lb. 11 Ozs.)
30 Cwt. Hammer 83·14 H.P.
15 Cwt. Hammer 40·6 H.P.
7 Cwt. Hammer 24·1 H.P.
All Hammers Running Light 6·03 H.P.
"THE ENGINEER"
SWAIN Sc.

FIG. 3—AMMETER CHART MADE DURING TEST OF HAMMERS

7 cwt. hammer only one. The motion of the shackle is obtained by attaching a cord to the control lever E, and coiling it round the winch drum G. The cord is continued downwards to a suitable length and finishes at a handle which is arranged at a convenient height for the hand of the operator. A pull on the handle immediately engages the brakes, and the hammer rises; when the tension is taken off the brakes are released and the hammer falls. We particularly noticed the ease with which even the largest hammer could be manipulated. So far as the effort necessary was required, a child of tender years could easily have done what was required. The releasing of the brakes is effected by the action of the adjustable spring H. A practical feature of this lifter is that it gives an absolute control of the tup. The hammer can be lifted to any height and allowed to fall, or it can be suspended in the rods at any point and held perfectly stationary.

We understand that a test of the installation was carried out in the works at Coventry under the supervision of Mr. Pullan, Inspector for Messrs. Sandberg and Co., who are consulting engineers for the railway. A facsimile of the recording ammeter chart which was made while the test was in progress is reproduced in Fig. 3. As will be observed, it gives some extremely interesting information. In the first instance, all the hammers were running light, that is to say, they were not being actually lifted. The portion of the chart referring to this particular part of the test is at the extreme right. The actual power absorbed, it will be seen, was only 6.03 horse-power. It may be explained that the motor is of 47 rated horse-power, but is capable of considerable overload. The hammers have an aggregate total of 52 cwt. without reckoning the top dies, which, of course, will bring an added weight of about 20 per cent. The small power required to "run light" bears testimony to the efficiency of the gear-box, and to the small amount of friction in gearing and shafting. It is quite clear that the friction blocks must have been perfectly free from the lifter grooves.

Following this test, the three hammers were tested in rotation, and the following results were obtained :—

Weight of hammer.	Horse-power absorbed while lifting.
7 cwt.	24.1
15 cwt.	49.6
30 cwt.	83.14

It will, of course, be realised that immediately the pull comes, the recording lever of the ammeter immediately flies up; the average horse-power required to drive the hammers is, naturally, considerably less than the figures indicated on the chart.

In the third part of the test each hammer was, in turn, kept suspended, and the power to effect that condition was ascertained. This portion of the trial is, perhaps, the most interesting of the whole. There was no driver working the hammer, but to take the place of the pull of an operator a small weight was suspended from the end of the working cord, washers being added so as to give just the amount of weight required to cause the hammer to rise and remain in the rods. All the hammers were treated in this way individually, and the power absorbed was as follows :—

Weight of hammer.	Horse-power absorbed.	Weight on handle.
7 cwt.	14.75	1 lb. 11 oz.
15 cwt.	26.82	2 lb. 8 oz.
30 cwt.	42.91	3 lb. 3 oz.

In the next test two of the three hammers were operated together, with the following results :—

	Power absorbed.
(*a*) 15 cwt. and 7 cwt. hammers working together	53.64
(*b*) 30 cwt. and 7 cwt. hammers working together	84.4
(*c*) 30 cwt. and 15 cwt. hammers working together	107.28

In this case there was a driver to each hammer, and both hammers were worked as in actual service.

The final test consisted in having all three hammers suspended together, with weights tied on to the handle. The actual power taken by the motor under this test was 75 horse-power. It is to be noted that under this equilibrium test—where the hammer is suspended in the rods—the power taken to drive is less than that absorbed under tests Nos. 2 and 4, that is to say, it is less than the power taken while hammers were being lifted.

Messrs. Brett point out that this last equilibrium test was very searching, for if there had been the slightest tendency for the lifters to overheat it would at once have become apparent. They assure us, however, that, as a matter of fact, after all the above tests had been taken the mechanism was perfectly cool throughout, and they remark that the fact that it was so goes to disprove the theory that an external cooling device should be an essential feature of drop-hammer lifters. It should, however, be remarked that with this form of lifter the drums are continuously rotating in the air, which naturally has a cooling effect. We believe we are right in saying that no drop hammer had ever before been subjected to an equilibrium test of this character.

No particular comment is necessary on the general construction of the hammers, which conform to the general practice introduced by this firm many years ago. We may, however, remark that, whereas the brakes of Messrs. Brett's lifters used to be of phosphor-bronze, they are now made of a special material which has been invented by Mr. Herbert Froode, of Ferodo, Limited. The material is not, we understand, on the market in the ordinary way, but is made specially for Messrs. Brett, who state that it gives an excellent friction surface. The base blocks of the hammers are of cast iron, and they are of massive construction, being about fifteen times the weight of the tup. The overhead work is supported by strongly riveted steel girders, and the whole of the structure throughout is on ample and heavy lines. As is well known, there is no class of appliance which receives more severe punishment than a drop forging installation, and that fact is evidently kept well in view by Messrs. Brett.

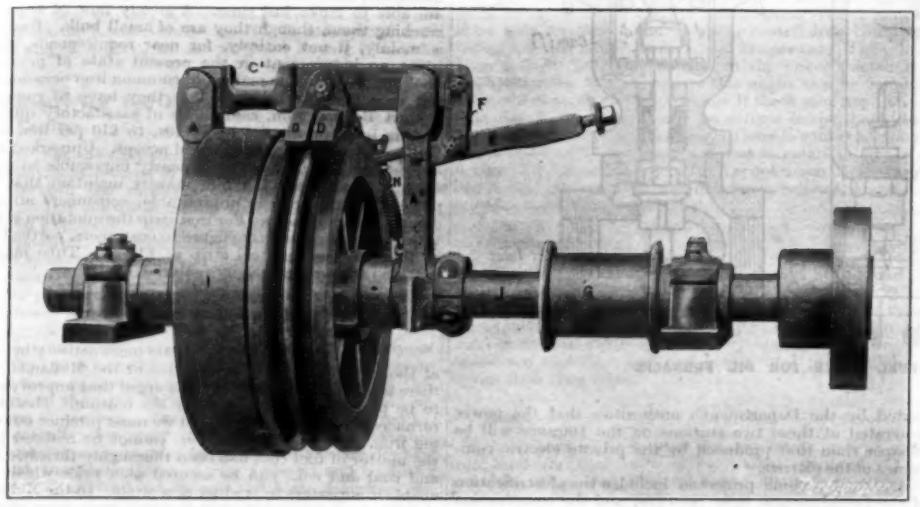


FIG. 4—LATEST TYPE OF BRETT LIFTER MECHANISM

Railways in British Malaya.

ACCORDING to the report of Mr. P. A. Anthony, M. Inst. C.E., the general manager of the Federated Malay States Railways, there was a net profit last year on the working of the lines under his charge of only £65,704. In other words, the earnings were only 0.39 per cent. on total capital expenditure. The figures compare with £386,218 and 2.67 per cent. respectively. The main factors contributing to the large decrease in profit were :—(*a*) Increases in rates of pay and allowances to the staff; (*b*) increased cost of materials of almost every description used in railway working, whether locally produced or imported; (*c*) a corresponding increase in all branches of contract work; (*d*) and trade depression consequent upon the fall in price of rubber and tin.

The percentage of increase in the pay of the clerical service was from 56 to 90 per cent.; in the traffic-operating grades, from 80 to 106 per cent.; and to the monthly paid subordinate staff, 75 per cent. Furthermore, in addition to an increase of pay by 25 per cent., the daily paid staff were supplied with rice and bread at cheap rates, making in all an increase of about 60 per cent. Materials, stores and railway equipment show increases in cost from 50 to 500 per cent.

With a view of maintaining the railways on a paying basis, it has been necessary to increase the terminal charges pertaining to goods train traffic and to increase the rates for parcels and perishable traffic carried by passenger train. A ferry toll was introduced on traffic by the ferries between Johore and the island of Singapore; but a reduction in passenger fares from 50 to 25 per cent. above pre-war rates came into operation on January 1st, 1920, and there was an increase of 3,227,315 passengers carried. Passenger traffic by the through railway between the Federated Malay States and Siam increased during the year, but there was a falling off in goods traffic consequent on the suspension of the export of rice from Siam throughout the year. Stores and materials to the value of £1,031,420 were purchased during the year, representing an increase of £212,072, as compared with 1919. The tonnage in respect of the Crown Agents' shipments aggregated 7785 tons, as against 2267 tons in 1919, in addition to which 103 tons and 3774 tons were received from Canada and Australia respectively.

The new line from Pasir Mas to Rantau Panjang, in Kelantan, with a total length of 11 miles 37 chains, was opened on September 1st. The total mileage of running lines—reduced to single track—open on December 31st last was 1014 miles 67 chains, including the Johore leased line, and of running lines and sidings 1150 miles 71 chains. There are now 222 permanent stations and 24 flag stations or halts open for traffic.

The total capital expenditure to December 31st last was £16,815,706. During last year a sum of £2,386,156 was spent, of which £741,282 was in connection with the construction of new lines, £919,605 for widenings and additions, including new wharves, &c., at Prai and the Johore Causeway to connect Singapore with the mainland, and £419,795 for new rolling stock. Receipts from all sources amounted to £2,020,262, as compared with £1,745,037 in 1919. In spite of the reduction in fares, passenger receipts increased by £183,907, and goods train traffic brought an increase of £49,033. The expenditure on all accounts amounted to £1,954,557. Under locomotive running expenses, very heavy increases are recorded, notably £102,309 for fuel, due to the insufficiency of local supplies, necessitating the purchase of coal at very high prices. The cost of fuel per engine mile increased from 28 cents in 1919 to 39 cents in 1920. The total running costs per engine were 64 cents for 1920, as compared with 46 cents for 1919. During the year 104 ocean steamers called at Port Swettenham with import cargo, as against 63 in 1919, and 60 ocean steamers called for export cargo, as against 32 in 1919. These figures are exclusive of the British India Company's steamers, which call regularly at the port.

Sixteen new "P" class locomotives were received from the North British Locomotive Works, Glasgow. Four "Q" class "Pacific" type locomotives, purchased in 1919 from the Baldwin Locomotive Works, Philadelphia, were also erected and added to the stock during the year, thus making an addition to the open-line stock of twenty new locomotives. Orders for forty new locomotives were also placed during the year—twenty "L" class from England and ten six-wheel coupled side tank locomotives from Baldwin Locomotive Works for the open line, and ten tender locomotives from the Baldwin Works for the construction department. The open line stock of locomotives, including the steam rail motors, was 204, and of construction department locomotives twenty-two at the end of the year. The total engine mileage, including maintenance ballast miles, for the year under review was 5,666,121, as compared with 5,006,936 in 1919. The train mileage was 3,940,732, as against 3,463,405 in 1919. The average daily miles per engine actually at work was 108.6.

Thirty-two mail type bogie passenger carriages were newly built at the works and turned out to traffic, as against eighteen in 1919. One was a bogie sleeping saloon of a new design, with transverse berths instead of longitudinal berths, as in the old sleeping coaches, and all the eight double-berth cabins are of the same size. Twenty-one mail type bogie passenger carriages were under construction at the end of the year; 248 coaches of all types passed through the shops for heavy and light repairs, as compared with 226 in 1919. The total stock of bogie goods vehicles at the end of 1920 was 169, as compared with 132 in 1919. The construction of 47 bogie flat wagons was in progress at the end of the year; 374 wooden wagons were constructed at the central workshops. In addition to the foregoing, 340 covered goods—steel—were received from the Crown Agents and erected at Port Swettenham on contract by Messrs. D. G. Robertson and Co. These wagons are part of 500 steel covered goods ordered in England in 1919. Ten fish vans were in process of construction.

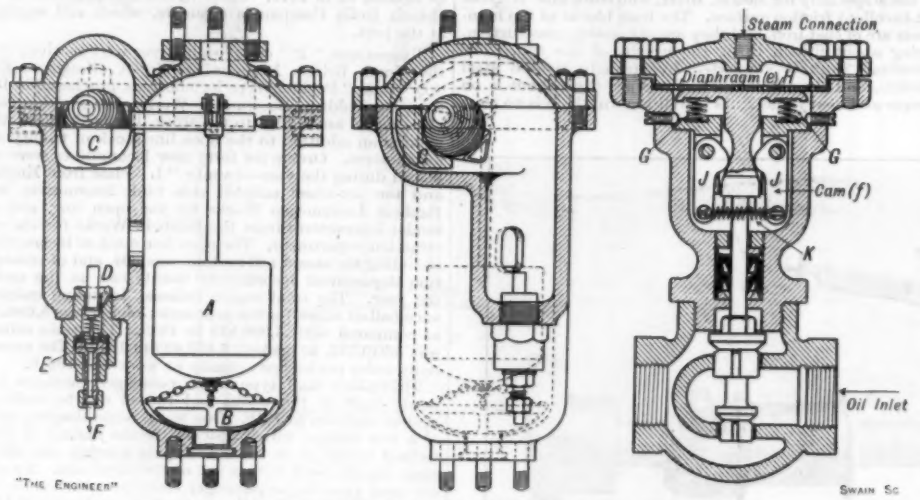
The total expenditure during the year on construction and surveys of new lines in the Federated Malay States, Straits Settlements, and Johore amounted to £1,661,088, as compared with £893,246 in 1919. Both in Kelantan and in Pahang progress was made towards the completion of the East Coast Railway, which will run from Gemas in the south of Selangor to Tumpat in Kelantan. The extension from Pasir Mas to Rantau Panjang, a distance of 11¼ miles, which joins the Siamese system, was opened for traffic in September last. After an interval of six years, work was recommenced on the Penang Hills Railway, and preliminary work begun on the Kuala Kubu deviation of 5¼ miles. The survey of the new line from Malacca to Gemas—44¼ miles—was completed, and a survey was under progress with a proposed line from Kuala Krau to Kuantan, in Pahang. The lines from Kuala Lumpur to Port Swettenham, from Batu Junction to Kuala Lumpur and Sungei Besi, and from Woodlands to Fort Canning (Singapore) are to be doubled, and the work was under way at the date of the report. New engine and carriage sheds and a goods yard were under construction at Ipoh, in Perak, and considerable progress had been made with the additional goods and marshalling accommodation at Kuala Lumpur, in Selangor, and the new carriage and engine accommodation at Seremban, in Negri Sembilan. A contract for the erection of six go-downs—warehouses—at Teluk Ayer Reclamation, Singapore, was let to Messrs. Robert Young and Co., Penang, the price being £166,063. The Federated Malay States Railways are constructing departmentally a reservoir and dam at Bukit Serayah, about 11 miles from Prai, for the supply of water for Prai and Bukit Mertajam. On that work £33,845 was spent during the year. Two of the largest pieces of work in hand are the reclamation of the foreshore and construction of wharves and go-down accommodation at Prai, Province Wellesley, opposite the Island of Penang, and the construction of the causeway across the Straits of Johore to connect the island of Singapore with the mainland, and provide for a double line of rails and a motor road—see THE ENGINEER, April 30th, 1920. Both contracts are being carried out by Topham, Jones and Railton, Limited. Good progress was made with the jetty at Prai, 213 of the concrete cylinders being sunk up to the end of the year out of the 323 required. The cylinders are all founded in the layer of coarse sand at about 53ft. below low-water level, and have all passed the prescribed loading test. The concrete hearting for the cylinders and the mass concrete capping beams are being proceeded with, and a start has been made with the reinforced concrete decking. It is expected that about 850ft. of jetty will be opened for traffic at the end of the present year. The supply of labour is plentiful, and 52 Europeans and 2000 Asiatics are employed on the works. The value of the work done at the end of 1920 was £431,650, or about 38 per cent. of the whole contract.

Good progress was made with the work on the Johore causeway. The construction of the lock at Johore was well advanced, and the north wall of the lock was about one-half completed. In addition, the first two lengths of the east and west wing walls were built. The eastern portion of the water-tight cofferdam enclosing the south wall of the lock was ready for closing at the end of the year. During the year, 18,100 cubic yards of excavation were removed from the site of the lock, and 5480 cubic

yards of concrete were deposited in the lock walls. On the Woodlands side of the Straits, 83,222 cubic yards of stone were deposited. The expenditure during the year on this work amounted to £141,117.

A Safety Device for Oil Furnaces.

IN view of the fact that oil-fired furnaces require little attention, as compared with those burning oil, there is always the possibility that serious damage may be done to oil-fired boilers through the attendant neglecting to remedy a shortage of water. If the heating surfaces are left dry by the falling water, the intense heat of the fire will quickly cause an accident, and it is thus desirable that some provision should be made to put out the fire in the event of the water in the boiler falling below the safe level.



FIGS. 1 AND 2—SAFETY DEVICE AND FUEL VALVE FOR OIL FURNACES

The device shown in the accompanying drawings has been brought out by Ronald Trist and Co., Limited, of 4, Lloyd's-avenue, London, E.C. 3, with the object of providing an apparatus for that purpose which is automatic in its action. The apparatus comprises a chamber —Fig. 1—in communication with the water space of the boiler, and a valve—Fig. 2—arranged in the pipe supplying oil fuel to the burners. The chamber is arranged at the normal working level of the water in the boiler, and is connected with the steam and water spaces by means of pipes bolted to the flanges at the top and bottom. Inside the chamber there is a bucket A, with an open top, beneath which there is suspended an anchor weight B. The bucket is hung from a short lever on a spindle running across the top of the chamber. At the other end of this spindle there is a counter-weighted, cast iron cradle C, in which rests a gun-metal ball weighing about 3 lb. The form of the cradle is such that there is little likelihood of the ball being dislodged accidentally, and the makers say that the rolling of a ship will not make it come out of the cradle. If, however, the water level in the boiler falls below a predetermined limit, which is generally such that four-fifths only of the bucket A are immersed, the weight of the bucket turns the spindle and tips the ball out of the cradle. The ball then drops down in the pocket below and strikes the plunger D. This plunger is furnished with a sharp point which punctures the capsule E, arranged below it. As soon as the capsule is broken, steam can escape by the pipe F, and is used to operate the oil stop valve, shown in Fig. 2. In order to re-set the apparatus, the plug at the bottom of the pocket is taken out and fitted with a new capsule, while the ball is pushed back into its cradle by a stick inserted through the plug hole.

The oil valve, as will be seen from Fig. 2, is of the double-beat type, and is kept open by a set of springs G G. The valve is closed by the steam pressing on the top of the diaphragm H. In the event of the valve being closed, the two cams J J are drawn together by the springs K and grip the valve spindle by the recesses shown, so that the valve cannot be accidentally reopened. A sealed inspection door is provided for releasing the cams when it is desired to open the valve again.

Projected Public Works in the South of France.

THE Bouches du Rhone, the Department of France in which the town of Marseilles is situated, proposes to undertake in the near future a number of costly and far-reaching public works, and, according to the British Consul-General at Marseilles, an account of these works was given at a recent meeting of a Marseilles society by the Chief Engineer of the Department.

The first scheme is for the construction of hydro-electric works on the Durance, and the utilisation of the power thus generated for the irrigation, by means of water drawn from the Rhone, of the Plain of the Crau, and for the reclaiming, by means of pumping, of the Plain of the Camargue in the Rhone delta.

This scheme will involve the construction of a small dam on the Durance, from which the water, calculated at an average volume of 150 cubic feet per second during the six months of high water, although considerably less during the remainder of the year, will be deflected to a power station at Meyrargues, where it is estimated that an average of 32,000 kilowatts will be generated. After leaving this station the water will be carried by a canal to a second one, situated at St. Christophe, also with a capacity of 32,000 kilowatts in normal conditions, the two works together thus producing a total of 64,000 kilowatts. The power generated at the Meyrargues station will be utilised for pumping water to the arid plain of the Crau, familiar to travellers from Arles to Marseilles for its dreary flats of waste, stone-littered ground, and for drawing off the salt water from the adjoining plain of the Camargue, whose enemy is not drought but sea water. The St. Christophe power station will, on the other hand, be used to supply electricity to Marseilles and the Department of the Bouches du Rhone for various public services, in the proportion of three-fifths for the town and two-fifths for the Department. Any surplus available when these needs are satisfied is to be placed at the disposal of electric light and power companies, on certain conditions regarding the price to be charged by them to the public. It is estimated by the Department's authorities that the power generated at these two stations on the Durance will be cheaper than that produced by the private electric companies of the district.

A second scheme projected includes the electrification of the Departmental light railways, and the construction of new lines between Salon and Marseilles, and between Martigues and Marseilles, to supplement the existing facilities by ordinary rail. The third and already well-known scheme is for the construction of waterworks at Fontaine l'Eveque (Var) on the river Verdon, a tributary of the Durance, for the purpose of providing Marseilles and Toulon with a constant supply of pure drinking water.

The cost of these schemes is estimated as follows :—

	Francs.
Power stations on the Durance and running of power lines	160,000,000
Works on the Crau and Camargue	36,000,000
Extension and electrification of Departmental railways	80,000,000
Fontaine l'Iveque waterworks	245,000,000
Total	521,000,000

Of this total of five hundred and twenty-one millions of francs, or £20,840,000, the Department of the Bouches du Rhone will have to provide the following sums :—

	Francs.
Power station at St. Christophe (that at Meyrargues is to be constructed by the State)	70,000,000
Works on the Crau and Camargue	12,000,000
Extension and electrification of lines	80,000,000
Fontaine l'Eveque waterworks	90,000,000
Total	252,000,000

It is estimated that the power station on the Durance and the Fontaine l'Eveque waterworks will pay for themselves out of the proceeds of the sale of power and water, while it is confidently anticipated that both the State and the town of Marseilles will contribute generously towards the cost of the railways and the works on the Crau and Camargue, these latter being more especially of national importance, as destined to restore to agriculture large tracts of land which only require water in the one case and draining in the other to become exceptionally fertile.

The projects have not, with the exception of the waterworks, for which a Bill is before Parliament, passed beyond the preliminary stages, but now that the Department has taken them up and given them such publicity, it is assumed that it is intended to carry them into effect with as little delay as possible.

INSTITUTION OF NAVAL ARCHITECTS: SCHOLARSHIP AND PRIZE AWARDS.—The Institution of Naval Architects' Scholarship (1921) has been awarded by the Council of the Institution to Mr. S. A. Hodges, and the Earl of Durham Prize to Mr. T. A. Davies, both of H.M. Dockyard, Portsmouth.

CONTRACTS.—Ed. Bennis and Co., Limited, of 28, Victoria-street, Westminster, S.W., have recently received orders for the supply of twenty-one sprinkling stokers, eight chain-grate stokers, four coking stokers, four ash-handling plants, one ash elevator, and one complete coal and ash-handling plant.

SALE OF SHAWBURY AERODROME.—The great aerodrome at Shawbury, seven miles from Shrewsbury, has been placed by the Disposal Board in the hands of auctioneers for complete dispersal. It includes electric lighting and power plant, engines, pumps, storage tanks, and water-heating apparatus, together with timber, corrugated iron, brick and slated buildings, flight sheds, workshops, &c. During the war the Shawbury aerodrome trained a large number of English, Australian, Canadian and South African officers for the Royal Air Force. Thomas Whitfield and Son, of Shrewsbury, have been entrusted with the sale by auction of the contents of the aerodrome, which will take place on September 6th, 8th and 9th.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Drop in Galvanised Sheets.

As the result of the fall in prices in the semi-finished manufactured steel market, sheet bars and billets which form the raw material for galvanised sheet rolling, have become cheaper, and galvanisers have been able to reduce their prices. It is reported that sheet mills are being offered some overflow of business which continental makers are too busy to entertain, but the prices suggested are such as to leave no profit on British production costs. Producers are ready, however, to make considerable cuts to obtain good orders, and a substantial drop in prices has occurred. The drop is from £2 to £2 10s. per ton, the former price of £22 to £24 for 24 gauge sheets having now become £20 to £22. It is stated that even less than these figures has been accepted for good export orders, though £22 is still quoted for small business. Activity in the iron trade continues to be almost entirely restricted to the makers of best bars, who are becoming rather busier and are able to make full time. A steady flow of orders is reaching them, though they are of small bulk. Business is mainly, if not entirely, for near requirements, there being no inducement in the present state of prices to book far ahead. The makers of common iron occasionally put in a few days a week, but they have to complete against Belgian iron, said to be of satisfactory quality, coming into the district at £9 10s. to £10 per ton, fully £5 lower than local makers could accept. Unmarked bars are retained at £16, but it is nearly impossible to make sales at that figure. While makers maintain that the present selling price is unprofitable, consumers are still demanding reductions. For iron strip the quotation is £20, which is not an attractive figure to customers, particularly as they can secure steel strip at £17 5s. Tube makers continue to use the cheaper material.

Pig Iron Prospects.

There appears to be a little more activity in some of the branches of the iron trades of the Midlands, and there is less unemployment. It is urged that improvement to be permanent must begin at the bottom. The blast-furnaces must be rekindled, and we must produce our own pig iron. This result, however, cannot be realised until the matter of fuel cost has been thoroughly thrashed out, and coal and coke can be secured at a price which will enable ironmasters to produce at a profit. In the Midlands the furnaces operating in Derbyshire have been started chiefly to furnish material for the founding of cast iron pipes, although most of the firms have a little iron to spare for sale. The demand is very poor, and the manufacturers are confronted with successful Belgian competition. The Manchester foundries are a little busier, it is reported here, and are calling for a certain amount of material from Derbyshire. Forge iron is rather plentiful, quite a lot of material still being available at the furnaces. Belgian foundry iron, which appears to answer consumers' requirements, can be bought in this district in what appears to be sufficient quantities at £6 10s. to £6 15s., which is £1 5s. to £1 10s. below the figures at which those having native foundry iron are able to place it on the market. The usual price for Midland foundry iron is about £8 5s., and the material cannot be produced more cheaply, according to the makers, until coke is much reduced in price. Blast-furnaces are slow in getting into action. Though coke is still too dear to enable pig iron to be produced here in competition with the foreign article, it is believed that the pressure for a reduction of fuel prices will prove irresistible. With the supply so much greater than the demand, the hands of the coalowners will be forced. Everywhere collieries are working short time, and trucks already loaded await purchasers. The price of fuel must come, and is coming, down, and the prospects of blast-furnace resumption are becoming substantially better.

Steel Prices Still too High.

The new cut in steel prices, reported in the Latest News column last week, is a welcome contribution towards reviving the home trade, though it still leaves a substantial margin in favour of imported products. Indeed, none of the British prices for finished steel can be said to be competitive at present. Consumers say that prices must fall still further, and they are disposed to wait until the further fall occurs before placing their business. Local steel works appear to be getting busier. Having some stocks of pig iron on hand, and being able to make use of fair quantities of scrap, they are for the present doing without their blast-furnaces. Small steel bars rolled from Belgian billets can now be bought down to £11 10s., a price which is the outcome of keen competition for the small amount of business available. If the bars are rolled from English billets, the quotation is about £13 10s. Great satisfaction is expressed here at the better news both from Scotland and South Wales. It is understood that in Scotland confidence in the iron and steel trades is returning, and that large additions are being made to working staffs. In South Wales it is reported that a large contract for steel rails has just been secured, and altogether the prospects are brighter. It is understood in Birmingham that the Belgian steel works are so full of orders that they will be kept out of the market for at least three months, while German shipments are, it is stated, impossible under six weeks. It is hoped that before these competitors again appear in the market, prices of native material will approximate more to continental quotations, and that local firms will be able to hold their own, particularly as regards export orders. There is a fairly large sale of high carbon billets, and in this line also vigour is being shown, a reduction during the past week bringing the selling price down to £11. This figure compares with £26 10s. charged a year ago, and is rather a striking example of the drastic slump in prices. Some business is, however, now coming forward.

Traders and the Passing of E.P.D.

The iron and steel trades and numerous other industries hereabouts welcome the end of the notorious E.P.D., which has taken place this week. There are now some very heavy claims in this district for the return of moneys collected in the years of high profits to balance the losses which have since been sustained. There are cases in which sums at stake are so considerable that Birmingham manufacturers have had no hesitation in facing the disturbance and expense of getting out a special set of accounts in order to put their claims forward. Though the trade slump has been pervasive, its effects on Birmingham trading have varied a good deal in different lines of business. There has been such pronounced depreciation in iron and steel that a number of manufacturers whose financial year ends in September, December or March are actually having re-valuations made. The same course is being followed by some of the brass-founders. There has been such a fall in values in all the metal-working industries that stocks to-day are not worth anything like the figures put upon them eight or ten months ago, or even in the spring. This depreciation has been accompanied by a marked shrinkage in the volume of business aggravated by the prolonged conflict in the coalfields. To clear up the claims already entered and those which it is intended to enter will be a very big job, involving probably an appreciable reduction in the net yield of the duty, so that although E.P.D. ceases to operate at the end of August, we are far from having heard the last of it.

Coventry and Iron Founding Trade and Demand for Castings.

For the first time for a considerable period, the unemployment returns in Coventry have shown a reduction in both the totally unemployed and short time sections, but notwithstanding this fact the outlook is far from promising. Not only is the export trade almost at a standstill, but competition with the foreigner, even in the home market, is well-nigh impossible. Foreign-made articles are being delivered at English ports at 40 to 50 per cent. less than the British producer can quote for delivery at the destination specified by the customer. Locally, castings afford a striking instance in this respect, and in consequence we have the curious anomaly of foundries in Coventry remaining quiet while certain motor firms in the city with a fair amount of work still on hand in the light car department are almost held up for want of castings. The car manufacturers referred to, if not actually slowing down for this reason, are prevented from starting more men as they would otherwise do, and yet with the present cost of raw material and coal and ever-increasing overhead charges the home foundries can do little. The aftermath of the coal strike is being felt in earnest.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

Iron, Steel and Metals.

THE process by which British prices in the iron and steel trade are eventually to be brought into proper relation with the world's prices is going on steadily, but unfortunately far too slowly. People who are hoping for an early revival of trade will certainly be disappointed unless this process can be expedited; for if previous experience goes for anything, it is impossible to obtain any sound revival of trade until inflated markets have been deflated, and until prices have rested at the bottom for some months. This last has always been a preliminary to a real trade revival, and one does not see why there should be any exception now. There is constant talk about a revival of trade, but business men will do well not to allow themselves to be deceived by it.

Metals.

The further collapse in copper came rather as a surprise, even to those who have been persistent pessimists. There has been some reaction since, and a good deal depends upon whether holders of metal will stand firm. If there should be any panic in the present state of consumptive demand, the market consequences might be considerable. The opportunity to obtain a supply of cheap copper for future use would then almost certainly occur; and, in fact, even now it is difficult to believe that such qualities as best select ingot copper are not worth buying for stock. If we assume that standard copper may fall to £60 per ton, even then best select ought to be worth about £65 or £66. The large quantities of scrap copper and old metals waiting to be disposed of are certainly a menace to the market at the present time, and makers of ingot brass have been offering that mixture at £36 per ton. At the present prices of new copper and spelter, such a mixture contains £52 worth of metal, and yet makers of the mixture from scrap sell it at £36. Germany appears still to be the largest European buyer of copper, she having taken from America nearly twice as much as the United Kingdom during the first six months of the present year. This is further confirmation of the theory that German engineering business is making rapid progress. The prices for manufactured copper and brass have been reduced to a small extent again, strong sheets being now at £101 per ton, copper locomotive tubes, solid-drawn and brazed, at 1s. 2½d. per lb., and brass tubes, solid-drawn, at 1s. 0½d. Yellow metal rods are now quoted at 8d. per lb., and this seems a much more reasonable price than the £101 per ton charged for copper rods. Perhaps someone will explain why yellow metal 4 by 4 sheets should be £11 per ton more than yellow metal rods, whereas copper sheets and rods are at the same price. Tin has recovered a little from the slump, but one is still very uncertain as to the future. There seems to be a belief that the tinned food trade is expanding, and that as a consequence the consumption of tin-plates will quickly increase, so that the demand for tin from that section of the trade may revive. If this increased demand comes along before the Eastern holders of tin are too tired to keep their stocks any longer, then all may be well; but the uncertainty of the tin position is too great at present to make any forecast at all safe. Lead has been quite a firm market at comparatively high prices, and apparently the supplies for prompt delivery—that is, what are called "near supplies"—are small; but the actual supply of lead is increasing, and it is difficult to believe that the metal will be maintained long at a high level when every other metal is at a low level. Spelter is quiet and without much change. The outlook is uncertain because we do not know whether or not Germany is likely to press sales.

Pig Iron.

The market in Manchester for all kinds of pig iron is very dull and quiet. It is indeed a question whether there is any business in or demand for forge pig iron, or any kind of pig except foundry iron, and the demand for that is at a low ebb. Probably the cause for this is that the ironfoundries of Lancashire have not been getting their usual share of orders, and this must have been foreseen when foundry iron became dearer in Lancashire than it was anywhere else. The doubling of the railway rates has necessarily a very heavy handicapping effect on the Lancashire foundry business, for the lowest rates are now 10s. per ton, instead of about 4s. 3d., and the highest rates go up to about 25s. for Scotch iron. When Lancashire built up her foundry trade, Scotch iron could be brought to her foundries for about 6s. per ton. There has been a slight tendency to ease in the prices quoted for Derbyshire No. 3, and perhaps this might now be bought, delivered here, at £7 15s. per ton. If there were any Cleveland No. 3, the price would be a little lower than this, but it is difficult to find a seller. There is some Cleveland No. 4 at about £7 5s., delivered, but founders do not like it very well. Scotch No. 3 pig iron is not much in evidence, and would cost at least £10 delivered, or, say, about £1 per ton more than hematite!

Finished Material.

There is very little definite change in the market for manufactured iron and steel. Steel makers are more inclined to make concessions, and some low prices have been taken for export orders, but the gap between British and continental prices remains very big, although British prices are slightly lower and continental prices slightly higher than they were.

Scrap.

There is no market for any scrap except cast iron, and for that only a very small demand. The foundries which are working buy a little from time to time, but as work decreases the buying diminishes. Dealers here are trying to keep up the price of machinery scrap to £6 or £6 5s. per ton, but it is difficult, and one has a feeling that lower rates will soon have to be accepted. Special lots of textile machinery scrap keep up in the absence of any supply of Scotch iron.

Manchester Association of Engineers.

On Thursday, the 25th ult., about a hundred members of the Manchester Association of Engineers paid a visit of inspection to the works of the Derbyshire Silica Firebrick Company, situated between Buxton and Ashbourne. The party left Manchester at noon in motor cars, provided by various members of the Association, lunch being taken *en route* at the Palace Hotel, Buxton. The products of the works are highly refactory silica firebricks for use in gasworks, coke ovens, furnaces, &c. The whole of the processes and plant were thrown open for inspection by the visitors, who were much impressed by the machinery used for the manufacturing of bricks of all shapes and dimensions. The cleanliness of the works and surroundings was freely commented upon, and afforded a striking contrast to the conditions which frequently prevail in factories of this description. After the inspection tea was served to the visitors by the company, and a vote of thanks to the President, Alderman Fred West, by whose courtesy the visit was arranged, was proposed by Mr. Henry Pilling, ex-President, and seconded by Mr. E. G. Hiller, past-President. The return journey to Manchester was made through the magnificent Derbyshire scenery, *viâ* Yaulgrave, Bakewell and Buxton.

Industrial Management and Administration.

The great complexity of business relations in industry is constantly calling for greater skill on the part of the management of engineering establishments. Although as a rule much attention is given to the technical qualifications of men who control works, the science of administration is liable to be overlooked. A fuller knowledge of economic problems and of their inter-allied social and psychological reactions is almost equally as necessary for the workshop manager as technical skill. To meet this urgent and ever-growing necessity, a course of studies in industrial administration has been organised by the Manchester Municipal College of Technology, which I have pleasure in commending to the engineers of this district. This department has for its objects:—(1) To investigate all problems relating to industrial management and to collect and co-ordinate the information obtained with a view to assisting in the building up of a science of industrial administration; (2) to put all knowledge so obtained at the disposal of the business community and to organise classes and lectures for managers, workers and students; (3) to assist individual students by affording them facilities and guidance in conducting original research; and (4) to guide outside societies and associations in the choice of lecturers in particular subjects. The classes held in connection with the department include:—Full-time course in industrial administration; full-time course in industrial and social welfare; part time day and evening courses for students engaged either in the manufacturing and productive side of industry or in commercial and trading pursuits; and special short courses of lectures to foremen, &c. Both the full and part time day and evening courses commence in October next. They extend over two years, and the fees charged are such as to bring them within the means of all.

BARROW-IN-FURNESS, Thursday.

Hematites.

In North Lancashire there is at present only one furnace engaged in the production of pig iron, and across in Cumberland there is a furnace in blast at Millom and another at Cleator Moor, a total of three in the whole North-West of England. These furnaces are operating on special orders for which deliveries are required, and so far as the remainder of the works are concerned, there is no immediate sign of a renewal of activity. At Barrow there is no prospect of another start, and smelters there, as elsewhere, are still awaiting a substantial drop in the price of coal and coke, with an easing also in labour charges. Until this is brought about, no big activity can be expected. The sum of £6 is put forward as being a likely price that will induce business, but the current rate is a long way above this. There is a certain demand for iron, but apart from special wants now being catered for, there is no inclination to place contracts until heavy cuts are made in prices.

Iron Ore.

The activity in hematite ore mining is confined to one pit in North Lancashire—Roanhead—and to the Cleator-Egremont district of Cumberland. With only three furnaces operating, the demand is small, and nothing at all is being offered on outside account. No foreign ore is coming in at present.

Steel.

Idleness is still complete in the steel-producing plant at Barrow and at Workington. There is some work going on in the foundries, and the Barrow hoops works are pretty well employed again this week, French billets being used. Business in the ordinary run of steel sections is entirely in the background.

Shipbuilding and Engineering.

The joiners are now again at work in the Barrow shipyard. The works are mostly on short time, for only a few are engaged on Mondays and less on Saturdays. Work is slack in every department, and new orders are very scarce.

SHEFFIELD.

(From our own Correspondent.)

Coal Prices and Profits.

THERE is no doubt about the good influence which the reduction in the price of blast-furnace coke to 30s. has had on the pig ironmaking industry generally, as witnessed by the number of furnaces that have been relighted, and in view of the high cost of putting those furnaces into blast, it is quite obvious a spirit of confidence in the industrial future must be returning. At the same time it will be recognised that even that figure is economically at too high a level. In the opinion of pig ironmakers the price of coke will have to stand another 50 per cent. cut before the iron market is really reassured, and the way to this further reduction, of course, is by a fall in coal values. In some coalfields, I notice, liberal concessions are being made to consumers, but here in South Yorkshire that can scarcely be said. Indeed, as to larger steam coals, although excess of production over demand is only being avoided in some cases by laying the pits off for a day or so a week, owners are making a determined stand, apparently, to keep up prices, which it is even being suggested may tend to higher levels as soon as the demand strengthens. That attitude, however, appears to be a wrong one altogether, seeing that a very large percentage of the prevailing trade depression is due to the high price of coal. Logically, therefore, it must come down by some means in order to create demand, and if that demand is to be retained and developed coal values will have to be kept within reasonable limits. The men, who are working very well indeed, have seen by now how much wiser they would have been to have met the owners on the wages question without resort to such a costly strike; but the great problem of the moment is how to bring about a permanent and considerable increase in the output per miner in order to lower the cost of production per ton, thus enabling the colliery companies to be worked at a profit and at the same time to reduce the cost to the consumer, and in the opinion of those best able to judge the solution can only be found in more scientific and labour-saving means of coal-winning. Measures of that kind will not in future, I believe, be treated so antagonistically by the men, but if they are to be taken successfully—and some of the collieries in these parts are making the attempt—it seems only fair that the question of the extra expenditure involved should be treated very sympathetically by the Government, as regards taxation; for after all it is a matter which directly affects the industrial prosperity of the country.

Some Companies Do Well.

Perhaps, while sympathising fully with the difficult position in which collieries generally are placed through the long period of Government control followed by an unexpectedly early relinquishment of that control, leaving the mines in the chaotic condition into which they had gradually fallen during the "control" period, it is a fair inference to make that mining concerns, however much the directors may grumble, are not all working at a loss. Some must be making a profit. Many companies could be quoted, of course, so far as the coalfields in this part of the country are concerned, but to mention just one, there is the New Monckton Colliery. Certainly the profits for the past year were about £4000 down as compared with those of the previous year, but the company's balance sheet was made up to June 30th last, so that the twelve months' operations included two big set-backs, the three weeks' strike last autumn, when the datum line was in dispute, and the three months' strike or, as the men called it, a lock-out, in the spring. A mining concern which

can, under such circumstances, make sufficient to pay a 10 per cent. dividend, tax free, place £15,000 to reserve, and carry forward almost as much as the sum brought in, may be trusted to give a pretty good account of itself in more favourable times. The point I want to make is, that under fair conditions there is sufficient vitality in the British coal industry for it quickly to recover its temporarily lost export trade—which would contribute appreciably toward the normalising of some of the exchange rates—and to assure home industries of a plentiful and reasonably cheap supply of fuel. At present the only class of fuel in this coalfield giving clear indications of a slump is small stuff. Wagon loads of slacks, indeed, are cumbering the sidings at collieries, with the result that prices of this kind of coal have a rather weak tendency, which has led to the fall in coke and the re-lighting of furnaces.

New Coke Ovens.

For the same reason batteries of coke ovens are being put into commission again, which reminds me that I hear the United Steel Companies, Limited, are now putting the finishing touches to a couple of batteries of very modern coke ovens of the Koppers type, there being fifty-four ovens in each battery. This installation is at the company's Rother Vale Collieries at Orgreave, on the Rotherham side of the district, the developments, I am told, including an up-to-date tar distillation plant. The surplus gas from the coke ovens will not be wasted, as has so often been the case in the past, but conducted through pipe lines to the mains of the Sheffield Gas Company and utilised for lighting and domestic purposes. Without being positive on the point, I believe it is correct that this connection with the Sheffield mains has almost been completed, and it should not be very long before the coke ovens are lighted up. The question discussed above, viz., the price of coal, does not greatly affect the United Steel Companies, Limited, because the combination which it represents is being developed along lines which make it self-contained; thus the company owns collieries, ore-fields, blast-furnaces, steel melting furnaces, rolling mil's, constructional steel works, forges, foundries, harbours, ships, and even railways. It will not be the first company to supply coke-oven gas to Sheffield, for readers of the Sheffield letter will remember, perhaps, that a year or so ago the Tinsley Park Colliery Company entered into negotiations with the Sheffield Gas Company for the regular supply of a certain quantity of coke-oven gas. That quantity, I believe, has since been considerably increased, while there has been some talk of the Tinsley Park directors forming a subsidiary company specially to carry on this coke-oven gas undertaking. Nothing, however, has been heard officially of that matter yet.

Difficulties of Overseas Trade.

What an embarrassing period the last two or three years have proved to firms depending largely on overseas trade is plainly seen in many directions. One of the latest evidences is contained in a circular issued over the week-end to shareholders in the Sheffield company, Overseas Exporters (1919), Limited. The origin of this concern is interesting. A Sheffield manufacturer and exporter, chiefly interested in the South American markets, conceived a plan by which he hoped to convince Sheffield steel firms particularly that it was economically wasteful for firms to attempt to be both manufacturers and salesmen so far as overseas markets were concerned. His idea was that a corporation should be formed, the membership of which would consist of British manufacturers, to undertake a selling organisation abroad, including the transaction, on behalf of the manufacturer, of all business detail, such as freights, bills of exchange, credits, catalogues, correspondence, clearing house transactions, &c., the corporation to spread a network of expert travellers and commissioners in various foreign markets and to keep the firms that were members of the corporation well supplied with orders. The latter were to be placed with those members whose works lent themselves most to the production on mass lines of certain manufactures, the intention being that producing firms should be free to devote themselves entirely to the business of output, while the corporation's efforts were wholly in the direction of selling the goods. The author of the scheme secured as much publicity for it as he could and eventually, during the war, a private company was formed, called Overseas Exporters, Limited, with a nominal capital of about £40,000. The scheme thus took shape and in 1919 the company was reconstructed under its present title, the authorised capital being, I think, about a quarter of a million, though only a relatively small portion of the shares was issued. It was decided to operate in South America for a commencement and to concentrate for the time being on Brazil. The scheme had a considerable amount of support, not only from the Sheffield district, but from various parts of the country. At first the prospects appeared to be very promising, but financial and industrial conditions in Brazil made it impossible for the Sheffield enterprise to develop its scheme as rapidly as had been hoped, and after contending against these adverse conditions for some time the directors, as already intimated, have issued a circular to shareholders expressing regret that "owing to the action of certain creditors who have commenced proceeding against this company for the recovery of their accounts, we find it necessary to call the shareholders together to consider the position and the advisability of going into voluntary liquidation with a view to reconstruction. Our inability to meet our accounts as they have become due is due to various causes. Amongst them may be mentioned the financial crisis (which has affected this company very seriously, preventing it from obtaining discount on its foreign bills), the great fall in foreign exchanges, making it difficult for the company's debtors to meet their liabilities on due date, and complications caused through the coal strike." Formal resolutions will be submitted to a meeting of shareholders next week, and Sir William Plender is mentioned as liquidator.

New U.S.A. Tariff Effects.

Reverting to the question of the new American tariffs, to which reference was made in a recent letter, unless the deputation of Sheffield steel manufacturers now in the States with the object of inducing the American authorities to make some sort of a revision of the new terms meets with success, our trade with America will about come to an end. The position has already been explained in brief, but since then a Sheffield firm of hacksaw makers has written to me on the subject. The new duty of 30 per cent. *ad valorem*, with the addition of 15 per cent. for alloy content, the writer says, will completely prevent any British hacksaw blades being sold in the United States. A tariff of a similar amount on American hacksaw blades imported into this country would, on the other hand, ensure that every British manufacturer of these goods would be fully employed and workers in this trade are badly needing employment at the present time. American makers are exporting thousands of gross of blades into this country, the letter continues, whilst the large orders for hacksaw sheet, which this country used to enjoy, are rapidly disappearing. The position, I may emphasise, is particularly disappointing, inasmuch as since the outbreak of war very important developments in hacksaw manufacture have been made in the Sheffield area, and only the beginning of this year saw the completion of another new well-equipped works for the purpose. Of course, America is not the only market in the world, but there are people in that country who prefer the British article; beside, we cannot afford to lose such an important market without a struggle, so that it is to be hoped the Sheffield deputation will not have gone on a fruitless errand.

Why Belgium Cannot Buy from Us.

General trade conditions here show no particular change from those mentioned a week ago, except, perhaps, that the spirit of optimism is proving a little more infectious—which is quite a good thing and should be encouraged, for pessimism just now is as bad as poison. From all accounts matters are in very much the same state on the Continent. For example, a representative of one of the leading steel firms here has just returned from Belgium and says that in industrial centres like Liége and Charleroi many works have been closed down for a long time and others are doing next to nothing or working only half time, whereas under normal conditions, he says, these districts would be busy turning out mild steel, rails, general machinery and locomotives. This slackness, he adds, is not due to any shortage of coal, for supplies there are far above demand, so that considerable reserves are growing and miners are on short time. In Antwerp, too, large numbers of men are unemployed, while from 600 to 800 ships are laid up in the docks waiting for cargoes. But, as generally is the case here, Belgian manufacturers are hopeful that the worst has been seen, for good inquiries are being received for rolling stock, constructional steel and railway material generally. There is little demand there for carbon and high-speed steels just now, but whilst Belgian consumers would in the ordinary course turn to Sheffield for most of these requirements, our prices are so high that they are driven to satisfy their wants in France and Germany. All of which, of course, merely emphasises the very argument with which my letter was commenced—the vital necessity, by cheaper coal and coke—and therefore iron and steel—less burdensome taxation, more reasonable railway rates, and a greater production per man, to lower the cost of output.

NORTH OF ENGLAND.

(From our own Correspondent.)

Slightly Better Outlook.

ALTHOUGH the general trade position in the North of England still leaves much to be desired, it is gratifying to hear opinions expressed that the outlook is slightly better. Hope is entertained that with cheaper fuel and reduced working costs, which are being gradually brought about, operations at the works and shipyards will be greatly extended in the near future. In the iron and steel trade steady progress continues to be made to a return to more normal conditions, and preparations are being made to put several more furnaces into operation. The position of the coal trade is, however, causing anxiety. There is little or no foreign business, which is absolutely essential to the prosperity of the trade, and many pits have been laid idle.

Cleveland Iron Trade.

Although the volume of business actually put through continues to be on the small side, there seems to be a more hopeful feeling abroad, and this is reflected in the news that three more blast-furnaces are to be lighted up very shortly, two on foundry and one on basic iron. This will increase the number in blast in this district to seventeen, but even that is only a small proportion of the number usually working, and some of the makers are just as resolute as ever in their determination not to re-start until they can manufacture at a profit. The price of coke is still the chief obstacle to a general resumption of work. Orders are scarce simply because iron is at famine prices, but to re-start the furnaces even with coke at 35s. per ton would simply mean further losses, so the iron-masters declare. There are some Durham coke makers who refuse to entertain 35s. as a selling price for blast-furnace coke, but that is about an average figure for coke delivered at the works, and possibly it might be shaded for suitable business. But anything above 30s. delivered is regarded as too high, and so the majority of the makers are still marking time, until the pressure of events brings coke producers to make further reductions. In the meantime thousands of tons of cheap foreign iron is pouring into the district, and our foreign markets have been lost to us owing to our prohibitive prices. The home demand is not very active, but there is more inquiry, and if supplies were available a fair quantity of No. 3 Cleveland G.M.B. could be sold even at the present price, which is 135s. per ton. But there is scarcely any to be had, and consumers are having to mix with No. 4 foundry, which is offered at 125s., or with forge iron at 117s. 6d. per ton. Mottled is at the same figure as the forge quality, but white iron is half-a-crown cheaper.

Hematite Pig Iron.

With six furnaces now producing East Coast hematite, there is more of this iron on the market, and it is understood that makers are now prepared to accept 140s. for mixed numbers for both home and export. This is a drop of 20s. on the week, and should certainly stimulate business.

Iron-making Materials.

The foreign ore trade is still lifeless. Consumers have very large stocks, and still have deliveries to take under old contracts. The general quotation of 28s. for best Rubio ore c.i.f. is regarded as too high.

Manufactured Iron and Steel.

The steel works are gradually extending their operations, and fairly good outputs are being made at some of the works. New business, however, is slow in coming forward. The recent price cuts have not done much to stimulate demand, and makers are having to quote considerably less than the home rates to have any hope of securing foreign orders. This week steel billets have been reduced by £2 per ton, but the other quotations remain unchanged.

Ironstone Mine Closed.

A notable event in Cleveland, not without its melancholy aspect from the industrial standpoint, is the passing of the Brotton mines. With the sale of the pithead machinery, buildings, &c., the history of an ironstone undertaking which yielded the richest ore from the Cleveland strata is closed. Mining was commenced there in the early 'sixties, and the concern remained in the hands of the same firm (Messrs. Robinson and Co.) from beginning to end. The royalty which they worked was a very large one, the seam on one side extending half-way to Saltburn, and on the other connecting up with Lumpsey and Longacres. Ore of the quality raised there found a ready market in the rapidly growing iron and steel industries, and the undertaking steadily developed, until in the brightest days of its prosperity two pits were in operation, between six and seven hundred men were employed, and six to eight trains of mineral dispatched each day. The mine was on the point of exhaustion when the coal strike occurred.

The Coal Trade.

The general position of the Northern coal trade shows no improvement, and the whole situation seems to be one of anxious waiting. Unemployment has never been so extensive in the Northern coalfields as at the present time. Durham County is suffering very severely, and it is estimated that there are now 22,000 miners idle, while the number is increasing daily. In spite of the present blackness, however, there are optimists who are convinced that the worst has been experienced and that there will soon be a revival. Durham coal, it is pointed out, is almost essential to the progress of the world, because of its peculiar qualities, and therefore it is only a matter of time as to when the mines are once again in full working order. The coal market, however, continues on very quiet lines, and the export trade on which the Durham coalfield has always based its progress, seems to have vanished for the time being. The market is anything but stable, and while previous quotations still hold good, it is difficult to say whether a concession could be squeezed or not. At any rate, the forward position is anything but satisfactory, and there is no doubt that discounting could be worked for any loadings after early September. For the current week the turns are fairly well filled, but further ahead the situation remains as anxious as ever. Merchants report that the inquiries are only slow, and many of them predict that further lowering of values is almost inevitable if the foreigner is to be induced to buy here in any quantities. In the Northumberland steam coal section the position has shown a slight improvement on the week. It would seem that the lower figures have induced a few orders to be placed for best qualities, but second qualities and unscreened are still unimproved, and are not in any special favour. The Durham section is very dull indeed. There is, of course, some preferential trade for special kinds, and for the top grades of gas coals, but generally speaking little or nothing is being booked for any of the second or third classes of either gas or coking coals. Bunkers are plentifully offered, and except in the case of specials and primes they can be bought cheaply. The coke position is no better. Supplies are very limited, but the demand is very scanty.

SCOTLAND.

(From our own Correspondent.)

Miners and "Reform."

FOR some time past the conduct of union affairs has caused considerable dissatisfaction in Lanarkshire and other districts. The officials in the first-named have openly admitted that the system has defects, and announced their determination to effect drastic reforms if a new lease of office is granted them. The openness of these officials has in a measure disarmed criticism, but has also strengthened the movement for a clean sweep. The "reform" movement, which appeared to have died out, has revived. "Reform" candidates have been nominated for almost every office. Present officials naturally are doing their utmost to belittle the opposition movement, but their actions, culminating in the bringing back of Mr. Smillie to stand for the presidency, apparently indicate nervousness as to the issue. As I write, a ballot is being taken. It is not expected that the result will be known before Saturday. It has been reported that as many as sixty miners have been nominated for three vacancies on the Finance Committee.

Joiners Restart.

With the shipyard joiners back at work, an improvement at the Clyde yards is looked for. Practically

all the men turned out and many were re-engaged by their previous employers. It is said that more than 50 per cent. of the joiners found employment elsewhere, and consequently no difficulty was experienced in finding work for the remainder. Operations will be in full swing within a few days, and work resumed on vessels which have been held up on the stocks and in fitting-out berths. It is expected that other tradesmen besides joiners will now gain employment. Full time has already commenced in one yard on the upper reaches, and others will shortly be in a similar position.

Pig Iron.

The relighting of furnaces is still being proceeded with, and some are now ready to go ahead whenever fuel becomes a little cheaper still. Some furnaces are already employed on foundry grades, which are now very scarce. There is always a certain amount of business to be done in foundry qualities, both for home and export. Prices are still nominally unchanged, but concessions can be arranged for a favourable order. Imported material continues on a cheap basis, and home producers cannot hope for increased orders meantime. The restricted number of furnaces now in blast can easily satisfy all local orders for some time ahead at the present rate of consumption.

Finished Steel and Iron.

Prospects in the steel trade appear somewhat brighter. Though current business is very slow, more departments are coming into operation. Works, however, are still nominally quoting big prices, though open to accept considerably less for good specifications; as much as £3 to £4 under the latest published prices having been said to be obtainable. While this latter may be a case of the wish being father to the thought there is little doubt that a reduction to such extent would be of much more use than an occasional chip of £1 off prices. At the latter rate, a long time must elapse before local quotations reach the competitive stage. Orders for plates are scarce, and sheet makers are badly in need of fresh work. Some mills have only enough to ensure employment for a few days ahead. Inquiries from abroad are increasing, and though mostly of an unfruitful nature at present, they at least indicate that business can be had when conditions warrant it. On the other hand, imports from Germany, Luxembourg and Belgium are also increasing. The bar iron mills are very poorly placed, and practically with few exceptions only carry on from day to day. Steel and iron castings are almost idle. Stagnant conditions characterise the engineering trade in most branches. Home prices are altogether outside the foreign quotations, and every other day provides an instance of this fact. With costs here and there falling a little and freights cheapening somewhat, prospects are perhaps a trifle better. The promised reduction in fuel at the beginning of September is eagerly awaited.

Coal.

The coal market is still overwhelmed with supplies and colliery sidings are blocked with loaded wagons, while the repeated reductions in prices seem to be of little avail. There are, however, signs of an increase in the home trade. Holders are showing anxiety to meet buyers to the best of their ability in order that they may be persuaded to negotiate before prices drop to a profitless standard. Some large industrial concerns have already taken advantage of the cheaper coal in order to keep things moving, and others are expected to follow suit. The glut of supplies has been of some advantage to those purchasing house coal, in so far that the quality supplied is far better than anything delivered since before the war. The export trade was not so busy this week as last. Smaller orders were received in most districts, with the possible exception of the Lothians. Inquiries, however, are fair, though mostly for near ports. Quotations continue to ease and buyers naturally exert caution. Only about ten boats are being loaded at Clyde ports at present.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal and Costs.

ALTHOUGH it cannot be said that the buying of coal for export is at the moment on anything like a satisfactory scale, it is very evident that many coalowners are of the opinion that prices have now fallen to the level which makes production barely remunerative and any further reduction would mean an absolute loss. Official figures are not as yet forthcoming concerning the average cost of production, but it is reported that in some instances costs range from about 24s. per ton for through coal at the pithead to 28s. and in some cases to 30s. These figures, of course, represent a substantial decrease compared with the net pithead cost for the March quarter, which was 57s. 11d. per ton; but, even assuming 25s. as the average cost, it is estimated that coalowners must have an average price of over 42s. 6d. for large and 20s. for small to enable them to pay a wage of 55.83 per cent. on the standard rates of 1915. Seeing, however, that current market prices are 32s. 6d. for best steam large and 19s. for best steam smalls, it will be realised that it is quite impossible for that wage to be maintained. As a matter of fact, a pithead cost of 25s. per ton requires an average f.o.b. price of 30s. per ton to make production pay, and current market prices do not reach this figure. It is quite true that the coal export trade last week reached a record figure, the total being 419,083 tons, but it is doubtful whether this total will be maintained. It is of no little interest to note that South Wales coalowners have made a further substantial cut in the price of coals for domestic purposes. The companies which produce the best qualities have decided to reduce the price at the pithead by 10s. per ton as from September 1st. A reduction of 7s. 2d. per ton was made as from the beginning of August, and as a consequence the local Merchants' and Coal Factors' Associations agreed to reduce their prices by 8s. per ton. The latest cut will now bring down the pitmouth price to 35s. to 36s. per ton, and on this basis it means that as from September 1st the retail price for one-ton lots will be 53s. 6d. per ton. It is officially stated that coalowners have had under serious consideration the question of costs of production, but they decided to make the reduction above referred to in view of the present condition of affairs. It is pointed out, however, that this will be the rock-bottom price, and that it will be impossible to make a further reduction during the coming winter. Any alteration, in fact, which may take place will be in the direction of advancing rather than reducing the price.

Coal Mining Agreement.

The terms of settlement of the recent national coal strike stipulated that the miners should be entitled to 83 per cent. of the proceeds of the industry after the standard wage and standard profit of 17 per cent. of wages had been deducted, but the points respecting costs other than wages were left for the new Joint Board to settle, and, failing its agreement, provision was made for reference to an independent chairman. It is, however, satisfactory to find that the two sides have come to an agreement without invoking the services of an independent chairman. In years gone by it was not infrequently held that costs which should be set against capital account were included in operating costs, and that costs which rightly should be borne by subsidiary undertakings such as by-product plant were also placed against the coal production side of the industry. The new agreement arrived at, however, covers all these points. It is provided that quarries, iron and steel works, brickworks, coke ovens, by-product plant, fuel plant, patent fuel plants, merchanting and selling depôts, &c., shall all be excluded from ascertainments, but washeries and electrical power plants situated at and owned by the collieries are to be included. In fact, the agreement is altogether very comprehensive and should obviate any future cause of complaint as between the coalowners and the miners. Both sides are to have their own auditors, who will work together.

Miners' Federation and Contributions.

It is very evident that the miners' leaders realise the importance of the movement by the enginemen, stokers and craftsmen to re-establish their own organisation and cut themselves adrift from the South Wales Miners' Federation, and they see in this desire evidence of the discontent existing among the rank and file. Consequently the Executive Council has had under consideration the question of reducing the contribution of members, in order to lighten their burdens and incidentally to ward off their complaint that they are not getting good value for their money. The Council decided to call a coalfield conference, to be held yesterday—September 1st—in order to see what the opinion was regarding its resolution that the enforcement of the contributions of 2s. per fortnight should be suspended and a payment substituted of 1s. as from July 4th on the understanding that benefits shall only be payable on the basis on which payments of such benefits were made when the monthly contributions of 2s. were paid.

Coal versus Water Power.

The report that Italy is to save one million tons of coal per annum by using water power, which is being harnessed, will not be received with any feelings of satisfaction by South Wales coalowners and coal exporters, inasmuch as the market will be the loser of by far the greater part of that quantity of export trade and other markets will have to be found. Strikes or stoppages in the coal trade simply stimulate energy in other directions to find a substitute for coal, so that it is more than ever urgent that capital and labour should combine rather than oppose each other in producing coal as cheaply as possible, thus assisting to find an export outlet and provide the maximum amount of employment. While, however, Italy is going ahead with her water power schemes, it is to be noted that the Ministry of Transport, in a communication to the Newport Development Association concerning the Severn barrage scheme, states that, while it is impossible to say that the scheme will not be proceeded with at some future date when financial conditions are more favourable, there is certainly no prospect of its being carried out for some time to come.

Iron and Steel Trades.

The announcement made last week concerning Baldwins, Limited, having secured a contract for 17,000 tons of steel rails is confirmed, though the only additional information obtainable at the Swansea offices of the company is that the rails are intended for a projected railway in China. The news that the Ebbw Vale Steel, Iron and Coal Company, Limited, has decided to re-start its iron and steel plant has caused no little amount of satisfaction, especially among the workers, as when in full running order it means that work will be obtained by at least 5000 men. Guest, Keen and Nettlefolds, Limited, are re-starting at the Dowlais Works. The Blaenavon Company started its tire mill on Monday last, as also the steel rolling mill. The former has been at a standstill since the war broke out, but since then has been entirely re-equipped. Here and there activity is being resumed at tin-plate works, but in many cases men are only engaged on half-time.

Current Business.

Operations on the market continue to hang fire, and there is not much buying proceeding. Stocks of coal are still very heavy, and the failure to clear wagons promptly is operating to the disadvantage of many miners, as collieries are compelled temporarily to suspend working. Colliery salesmen are not disposed to make further concessions, especially for superior steam large coals, as working costs will not permit them to do so. Some collieries have steadfastly declined to accept less than 32s. 6d. for Admiralty large qualities and have definitely turned down fairly good orders at 30s. They prefer to stop pits rather than to accept this figure. Ordinary Cardiff large coal is obtainable at 30s., as also are some of the Monmouthshire descriptions, while superior steam smalls are still quoted at 19s., but ordinary cargo smalls range down to 10s. and 12s. 6d. There is no variation in coke. Pitwood is quiet owing to discharging difficulties, as wagons are scarce. The anthracite market is very steady for prompt supplies.

Latest News from the Provinces.

THE MIDLANDS AND STAFFORDSHIRE.

Large Steel Works Restart.

ALFRED HICKMAN, Limited, of the Spring Vale blast-furnaces and steel works, Bilston, near Wolverhampton, has this week intimated to its workpeople its intention immediately to re-start both sides of its works, which have been standing idle since the colliers' strike. Between 1500 and 2000 operatives are affected, and the news has created the widest satisfaction. The Spring Vale furnace plant includes five furnaces, and the firm has also decided to re-commission the furnaces of Lloyd's Ironstone Company, in Northamptonshire, which have been idle for a long while. It is expected that the production of pig iron at Spring Vale will be an accomplished fact by the end of this month, and that the whole of the furnace plant there will be in operation by the end of October. Cheap coke prices have been secured to enable the re-start to be made. In a normal state of trade the company consumes the whole of its pig iron output in its own steel works.

SHEFFIELD.

Sheffield Appeals to the U.S. Senate.

A considerable degree of satisfaction is felt in light steel circles here at the fact that the Sheffield deputation, headed by Mr. Arthur Balfour, which left for the States a week or so ago, with the object of endeavouring to call attention to the hardships that the new American tariffs would impose on Sheffield firms trading with America, has been permitted to appear before the Finance Committee of the United States Senate. This occurred on Tuesday last, and Mr. Balfour put up a splendid case for Sheffield. It is to be hoped the points he made will have carried conviction and will lead to a revision favourable to Sheffield.

Raw Material Prices.

It is now believed in pig iron circles that unless a further drastic cut occurs in blast-furnace coke, which is quoted at 30s., there will be no general revision downward of prices. On the other hand, some makers are suggesting an advance, though such a step would be incompatible with the general trend of markets. One furnace is in blast for basic in Lincolnshire and a comparatively few are blowing in Derbyshire, so that, as stocks are extremely low, a "squeeze" in pig iron would probably follow any appreciable revival in the steel trade. Derbyshire iron is now about £7 10s. for foundry and 20s. less for forge, though there is absolutely no call for the latter. The South Yorkshire Bar Iron Association meets on Monday, when it is not unlikely a further reduction may be made, though it is uncertain. The market is glutted with iron and steel scrap, which hardly anyone wants at the moment. Heavy stuff can be bought for £3 a ton and light material at as low as 20s. a ton, which is believed to be a new low record.

WALES AND ADJOINING COUNTIES.

Swansea Metal Exchange.

Tin-plate trade conditions continue to be very idle. Orders are extremely scarce, but despite this fact prices are surprisingly steady. The consignment of large quantities of tinned fruits, &c., to Russia raised hopes of an improved demand for tin-plates, but as against this it has to be borne in mind that large stocks of these goods exist as the result of heavy production during the war period. The fall in coal prices has induced some owners of tin-plate works to re-start some of their mills, but it is to be feared that unless new business comes along the mills cannot be operated for very long. The Cardonnel works at Neath have already re-started, and the Eagle works, also at Neath, commence next week.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. DENDY MARSHALL will be grateful for any information concerning Liverpool and Manchester Railway locomotives built between No. 69, Victoria, 1839, and 1846. Address, care of THE ENGINEER.

WE are asked to state that the sole agent in the United Kingdom for the Sharples super-centrifuge, manufactured by the Sharples Specialty Company, of New York, is United Water Softeners, Limited, Imperial House, Kingsway, London, W.C. 2.

CHARLES CHURCHILL AND CO., Limited, Leonard-street, Finsbury, London, E.C. 2, have been appointed the sole agents for Great Britain for the National Acme Company, of Cleveland, Ohio, U.S.A. The department is under the supervision of Mr. C. W. Simpson, at Manchester.

WE are asked to state that Messrs. Walter D. Fair and Co., 43, Sackville-street, London, W. 1, have been appointed sole selling agents for Kitchen reversing rudders of the tiller and wheel-controlled types in the London area, comprising the City of London and Westminster and the Thames basin from Gravesend to Staines.

WE are asked to state that the Government control of the railways having terminated, Mr. N. G. Gedye, M. Inst. C.E., has relinquished the appointment of Chief Civil Engineer for Docks, Harbours, and Inland Waterways in the Ministry of Transport and has resumed his private practice as a consulting engineer at 5, Victoria-street, Westminster, S.W.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	—
[1] Spanish	28/-
[1] N. African	28/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	37/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—[2]		
Hematite	9 0 0	—
No. 1 Foundry	8 15 0	—
No. 3 ,,	8 10 0	—
N.E. COAST—		
Hematite Mixed Nos.	7 0 0	7 0 0
No. 1	7 2 6	7 2 6
Cleveland—		
No. 1	—	—
Silicious Iron	—	—
No. 3 G.M.B.	6 15 0	6 15 0
No. 4 Foundry	6 5 0	6 5 0
No. 4 Forge	5 17 6	5 17 6
Mottled	5 17 6	5 17 6
White	5 15 0	5 15 0
MIDLANDS.		
Staffs. *(Nominal).*—		
All-mine (Cold Blast)	17 0 0 to 17 7 6	
Part Mine Forge	7 0 0	
,, Foundry No. 3	8 5 0 to 8 15 0	
Northampton [2] *(Nominal).*—		
Foundry Nos. 2 and 1	8 2 6	
,, No. 3	7 12 6 to 7 15 0	
,, Forge	6 17 6	
Derbyshire [2] *(All nominal).*—		
No. 3 Foundry	7 7 6 to 7 10 0	
Forge	6 10 0	
Lincolnshire [2]—		
Basic	*Uncertain.*	
Foundry	,,	
Forge	,,	
N.W. COAST— [4]		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	8 5 0	

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	16 0 0	—
Best ,,	17 0 0	—
N.E. COAST—		
Crown Bars	16 0 0	—
Best ,,	17 0 0	—
Tees	14 10 0	—
LANCS.—		
Crown Bars	16 0 0	—
Hoops	20 5 0	20 0 0
S. YORKS.—		
Crown Bars	16 0 0	—
Best ,,	17 0 0	—
Hoops	20 5 0	—
MIDLANDS—		
Marked Bars (Staffs.)	20 0 0	—
Crown Bars	16 0 0	—
Nut and Bolt Bars	16 0 0	—
Black Sheets (dbls. nom.)	17 0 0 to 17 10 0	
Galv. Sheets, 24 W.G. (f.o.b. L'pool, or equal)	20 0 0 to 22 10 0	
Gas Tube Strip	20 0 0	—

STEEL.

	Home.[6] £ s. d.	Export.[7] £ s. d.
SCOTLAND—[5]		
Boiler Plates	19 0 0	—
Ship Plates ⅜in. and up	14 0 0	—
Sections	13 10 0	—
Steel Sheets ⅛in. to ⅜in.	15 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	24 0 0

STEEL (continued)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	14 0 0	14 0 0
Angles	13 10 0	13 10 0
Boiler Plates	19 0 0	19 0 0
Joists	13 10 0	13 10 0
Heavy Rails	14 0 0	—
Fish-plates	19 0 0	—
Channels	14 10 0	—
Hard Billets	11 0 0	—
Soft Billets	9 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	14 0 0	—
Light ,,	17 0 0 to 19 0 0	
Billets	13 0 0	—
Ship Plates	14 0 0	—
Boiler ,,	20 0 0	—
MANCHESTER *(Prices irregular and uncertain, unchanged)*—		
[8] Bars (Round)	13 0 0 to 14 0 0	
[8] ,, (others)	14 0 0 to 15 0 0	
Hoops (Best)	20 5 0	20 0 0
,, (Soft Steel)	17 5 0	17 0 0
Plates	14 0 0	—
,, (Lancs. Boiler)	20 0 0	—
SHEFFIELD—		
Siemens Acid Billets	16 0 0	—
Bessemer Billets	15 10 0	—
Hard Basic	13 0 0	—
Soft ,,	11 0 0	—
Hoops	17 5 0	—
Soft Wire Rods	13 15 0	—
MIDLANDS—		
Small Rolled Bars	12 0 0 to 13 10 0	
Bessemer Billets and Sheet Bars	8 10 0	—
[3] Hoops	17 0 0	—
Tube Strip	12 10 0 to 13 10 0	
Angles and Joists	13 10 0	—
Tees	14 10 0	—
Bridge and Tank Plates	14 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	22/- to 24/-
Block Tin (cash)	156 10 0
,, (three months)	158 15 0
Copper (cash)	67 12 6
,, (three months)	68 5 0
Spanish Lead (cash)	23 5 0
,, (three months)	22 15 0
Spelter (cash)	24 17 6
,, (three months)	25 10 0
MANCHESTER—	
[9] Copper, Best Selected Ingots	69 10 0
[9] ,, Electrolytic	73 0 0
[10] ,, Strong Sheets	101 0 0
,, Loco Tubes	0 1 2½
Brass Loco Tubes	0 1 0½
,, Condenser	0 1 4½
Lead, English	24 10 0
,, Foreign	23 5 0

(Metal prices practically unchanged).

FERRO ALLOYS.

(All prices now nominal).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/6 to 1/8 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£36	12/-
,, 6 p.c. to 8 p.c. ,,	£34	12/-
,, 8 p.c. to 10 p.c. ,,	£34	12/-
,, Specially Refined		
Max. 2 p.c. carbon	£79	28/-
,, 1 p.c. ,,	£94	32/-
,, 0·75 p.c. carbon	£110	41/-
,, carbon free	2/8 per lb.	
Metallic Chromium	5/6 per lb.	
Ferro Manganese (per ton)	£18 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 10 0 scale 6/- per unit	
,, Vanadium	22/- per lb.	
,, Molybdenum	9/- per lb.	
,, Titanium (carbon free)	1/6 per lb.	
Nickel (per ton)	£190	
Cobalt	15/- per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	26/-
,, ,, Ell	27/-
,, ,, Splint	27/6 to 31/-
,, ,, Trebles	29/-
,, ,, Doubles	27/6
,, ,, Singles	25/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	26/-
,, ,, Splint	27/6
,, ,, Trebles	29/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	25/- to 27/-
Screened Navigation	32/6
Trebles	28/-
Doubles	26/-
Singles	24/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	25/-
Secondary Steam	24/-
Trebles	29/-
Doubles	27/-
Singles	25/-

ENGLAND.

[11] N.W. COAST—	
Steams	44/-
Household	56/8 to 60/-
Coke	47/6
NORTHUMBERLAND—	
Best Steams	27/6 to 30/-
Second Steams	25/- to 27/-
Steam Smalls	15/- to 17/6
Unscreened	22/6 to 27/-
Household	30/- to 35/-
DURHAM—	
Best Gas	30/-
Second	25/- to 27/6
Household	30/- to 35/-
Foundry Coke	45/- to 55/-
SHEFFIELD— [12]	
S. Yorks. Best Steam Hards	33/2 to 33/8
Derbyshire Hards	32/8 to 33/2
Seconds	31/8 to 32/2
Cobbles	31/8 to 32/2
Nuts	31/2 to 32/2
Washed Smalls	28/8 to 30/2
Best Hard Slacks	20/- to 25/-
Seconds ,,	20/- to 23/-
Soft Nutty ,,	20/- to 25/-
Pea ,,	18/- to 22/-
Small ,,	15/- to 18/-
House, Branch	37/2 to 37/8
,, Best Silkstone	33/8 to 34/2
Blast Furnace Coke	30/-

SOUTH WALES.

CARDIFF— [13]	
Steam Coals:	
Best Smokeless Large	34/- to 35/-
Second ,, ,,	32/6 to 33/6
Best Dry Large	32/6 to 34/-
Ordinary Dry Large	30/- to 32/6
Best Black Vein Large	30/- to 32/6
Western Valley ,,	30/- to 32/6
Best Eastern Valley Large	30/- to 31/6
Ordinary ,, ,,	27/6 to 30/-
Best Steam Smalls	18/- to 19/-
Ordinary ,,	10/- to 17/-
Washed Nuts	34/- to 35/-
No. 3 Rhondda Large	37/6 to 40/-
,, ,, Smalls	27/6 to 30/-
No. 2 ,, Large	27/6 to 32/6
,, ,, Through	20/- to 24/-
,, ,, Smalls	16/- to 18/-
Coke (export)	60/- to 62/6
Patent Fuel	32/6 to 35/-
Pitwood (ex ship)	25/- to 27/6
SWANSEA—	
Anthracite Coals:	
Best Large	55/- to 57/6
Seconds	55/- to 57/6
Red Vein	40/- to 45/-
Big Vein	55/- to 57/6
Machine-made Cobbles	70/- to 72/6
Nuts	72/6 to 75/-
Beans	60/- to 65/-
Peas	42/6 to 45/-
Breaker Duff	12/6 to 15/-
Rubbly Culm	20/- to 22/6
Steam Coals:	
Large	32/6 to 35/-
Seconds	30/- to 32/6
Smalls	15/- to 17/6
Cargo Through	22/6 to 25/-

[1] Delivered. [2] Net Makers' works. [3] At furnaces. [4] Delivered Sheffield. [5] Glasgow, Lanarkshire and Ayrshire. [6] Home Prices—All delivered Glasgow Station.
[7] Export Prices—F.O.B. Glasgow. [8] Prices represent the real market before the *official* change was made. [9] These prices are practically alike now.
[10] Sheets reduced while other prices are advancing. [11] Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export.
[12] For inland sales. [13] Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Strikes and Wages.

THE past week has seen no settlement of the strikes that have broken out in the Nord and in other parts of the country, notably at Strasburg, where the strike movement has considerably extended, and as the unions have taken up an uncompromising attitude it is not possible to foresee an early solution. It is certain that in the present stagnant condition of industry it is impossible for employers to give way. The purchasing value of money in the country has improved with an accumulation of stocks and a reduction in the cost of commodities; in other words, more value is obtained for the money spent, and consumers therefore insist that prices should continue to come down. Makers are well aware that selling prices must be reduced to attract business; but, having made all the sacrifices possible, to the extent in many cases of accepting contracts without profit in order to find employment for the men, they have no alternative to paying lower wages. So long as employers dealt directly with the men there was no difficulty in getting them to see the wisdom of accepting lower wages as a means of bringing in business. When a number of reductions had taken place the unions stepped in and insisted firmly on no interference with the rates of wages. As a case in point, the bakers' union in the Nord objected to a diminution in the price of bread because they feared it would entail a wages reduction. The theory of the unions now is that producers must make sufficient profits to pay the maximum rates of wages, quite forgetting the fact that high prices reduce the purchasing value of money and that lower prices and lower wages place the workers economically in a much better situation.

Trade Tendencies.

The present stagnation has lasted so long without offering hope of recovery that manufacturers are beginning to see the necessity of adopting some new commercial policy. The protectionist programme upon which so much was based has had the effect of completely isolating the country, and the improvement in foreign exchanges that was noticeable some months ago has entirely ceased, while it has become almost impossible to secure foreign contracts in competition with German and Hungarian firms. French locomotive builders failed to obtain a large order from Bulgaria despite the sacrifices they made. The situation appears so inextricable that some manufacturers believe the only solution lies in breaking down the barriers raised against Germany and Russia, with which countries they have so far refused to trade, and enter into some economic arrangement whereby business may be developed. At home, also, confidence must be revived by giving more protection to creditors whose interests are at present jeopardised by the "transactional settlements" granted to a class of debtors who can show, which is by no means difficult, that their failures are due to the effects of the war. Under that settlement they are allowed to pay a percentage of their liabilities with interest over a considerable number of years, with the result that a creditor may find himself practically deprived of large sums of money which under ordinary circumstances he could recover by the usual legal procedure. It is probable that the revocation of laws that were passed to enable defaulters to tide over financial difficulties would precipitate a crisis, but it is felt now that this is only prolonging the agony and that by eliminating the hopelessly weak elements it will be possible to bring about a stronger feeling of confidence.

Colonial Enterprise.

The difficulty of procuring wood during the war for construction purposes caused so much embarrassment to the railway companies that a commission was sent out to the West African colonies to investigate the ways and means of procuring supplies. After visiting the various territories the Commission settled upon the Gabon, where the forests contain all the varieties of wood required, and, despite the difficulties of exploitation, it was decided that the Gabon forests could supply everything needed, from wood for sleepers to material for wagon construction. Recently a technical staff was sent to the colony to organise the new industry, for which labour will have to be recruited from long distances and a great deal will have to be done in the way of road building. Notwithstanding the arduous character of the undertaking, it is regarded as offering an almost certain promise of success, and the railway companies have constituted a group which, it is hoped, will begin operations in the course of a few months, while it will have a small fleet of steamers for bringing the wood to the port of shipment.

Trade Returns.

The fluctuations of the exchange rate have so far increased the difficulty of estimating values that the Customs Commission admits the unreliability of the monthly returns and is considering the advisability of adopting a less arbitrary method of estimation. It found, for example, that by applying to the imports and exports during 1921 the system of valuation adopted in 1920 the results were entirely misleading, and the Commission therefore valued the exchanges during the first seven months of the present year according to the method employed in 1919. The result is that the imports fell to 11,876 million francs, representing a decline of no less than 18,366 million francs. The exports were estimated at 12,362 million francs, a decline of 1990 million francs. In order to provide a more accurate comparison the Commission publishes the weights, from which it appears that the imports during the seven months totalled 18,221,168 tons, representing a reduction of 9,391,830 tons, of which close upon 7,000,000 tons were raw material. The exports amounted to 8,520,320 tons, or 1,940,147 tons more than in the first seven months of last year. Nearly the whole of this increase was due to raw material. The returns show that far less raw material is being worked up into manufactured goods and much more is being exported.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

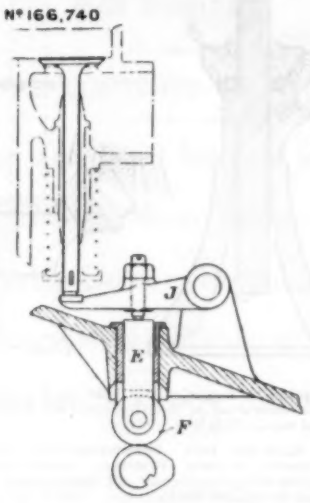
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

166,740. April 28th, 1920.—IMPROVEMENTS IN OR RELATING TO VALVE MECHANISM FOR INTERNAL COMBUSTION ENGINES, Joseph Maina, of 65A, Holborn-viaduct, London, E.C.

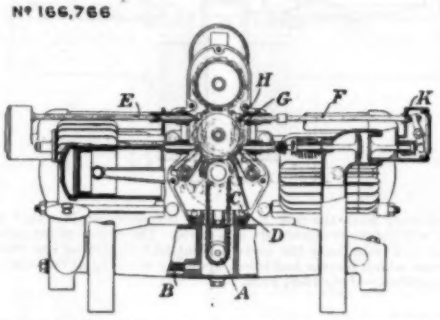
With this valve mechanism it is claimed that it is possible to obtain with a given diameter of cam, angle of cam and



lift of valve, an increased period of time during which the valve is fully open. The cam, at the lower part of the drawing, raises the roller F and tappet E, which in turn moves the rocker J and causes the outer end to raise the valve.—*July 28th*, 1921.

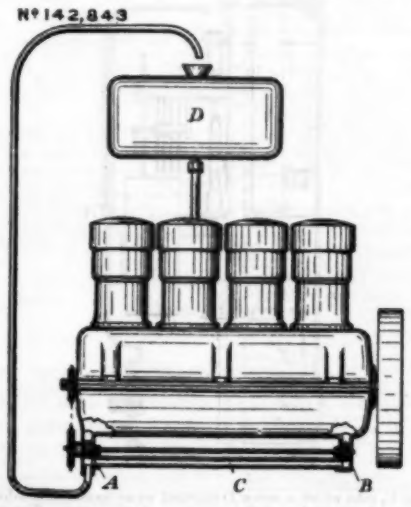
166,766. May 13th, 1920.—IMPROVEMENTS IN MEANS FOR LUBRICATING INTERNAL COMBUSTION ENGINES, John Wooler, of Wooler Motor Cycle Company (1919), Limited, Alperton, Middlesex.

The oil is picked up by an endless chain A and delivered to the crank case. B is a filter tube. The oil is lifted by the chain at a speed sufficient to throw it against a guard C, which conducts the oil to a channel D, whence it passes into the crank case, and is picked up by the crank pin bearings,



which are thereby lubricated. Oily vapour is conveyed to other parts of the engine in the manner shown, for example, by the two tubular valve rods E and F, the ends of which terminate in a chamber or space G open to the well. The rod F, for example, has an inlet H and an outlet K. Any number of tubular rods may be employed to conduct lubricant to the various parts of the engine in this manner.—*July 15th*, 1921.

142,843. July 28th, 1921.—IMPROVEMENTS IN OIL CIRCULATION MEANS FOR HIGH-SPEED INTERNAL COMBUSTION ENGINES, Mayhach-Motorenbau Gesellschaft mit Beschränkter Haftung, of Friedrichshafen-on-Bodensee, Germany.

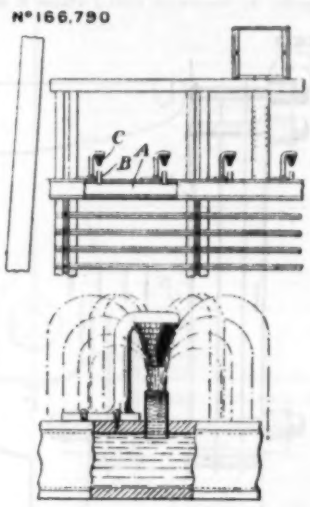


In the lower part of the crank case are two gear wheel pumps A and B, connected by a pipe C, which deliver oil to the container D. Each pump is capable of dealing with double the amount of oil thrown off by the moving parts. If in an inclined position of the engine, the entire quantity of oil which has been thrown off runs to one end, for instance, the fly-wheel end, the pump A becomes inoperative, whilst the B forces the entire quantity of oil into the main oil container D. The object of the invention is to prevent over-lubrication, as no oil can accumulate in the flat underpart of the casing, even with the maximum inclination of the machine.—*July 28th*, 1921.

CONDENSERS AND FEED-WATER HEATERS.

166,790. May 31st, 1920.—IMPROVEMENTS IN OR RELATING TO COOLING TOWERS OR STRUCTURES FOR COOLING WATER AND OTHER LIQUIDS, Francis Edward Gill, of 4, Spring Hurst-road, Shipley, and the Davenport Engineering Company, Limited, of 70, Harris-street, Bradford.

The object aimed at by the inventors is to cause the upwardly forced liquid to be more effectively sprayed over the cooling stack than hitherto. The liquid is conveyed into a

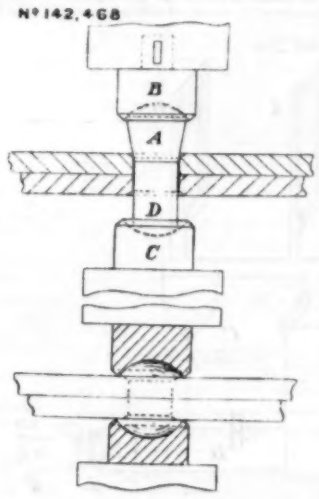


series of channels A, provided with tubes B, with cones C above, and the liquid delivered by the upwardly projecting discharge tubes B strike the cones, which split up the liquid into minute particles and cause it to be delivered over the cooling stack, as shown in the lower drawing.—*July 28th*, 1921.

MACHINE TOOLS AND SHOP APPLIANCES.

142,468. August 24th, 1916.—AN IMPROVED METHOD OF RIVETING, Ingenieur Emil K. Schuch and Co., G.m.b.H., of Hohenzollernstrasse 29, Munich, Germany.

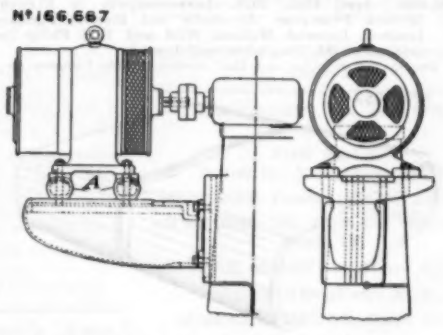
This specification describes a system of riveting in which a "blank" is used having an enlarged coned end A instead of the usual head. When the dies B C of the riveting machine are



applied they shape the two ends A and D exactly alike and make them correspond in size with each other. By this method the rivets are made perfectly tight and they require no caulking. Even under the highest pressures a fluid cannot, it is said, find a passage.—*July 26th*, 1921.

166,667. July 15th, 1921.—IMPROVEMENTS RELATING TO THE MOUNTING OF ELECTRIC MOTORS ON MACHINES, William Asquith (1919), Limited, of Highroad Well Works, Halifax, and George Feather, of the same address.

The motor bracket or mounting is so arranged and constructed



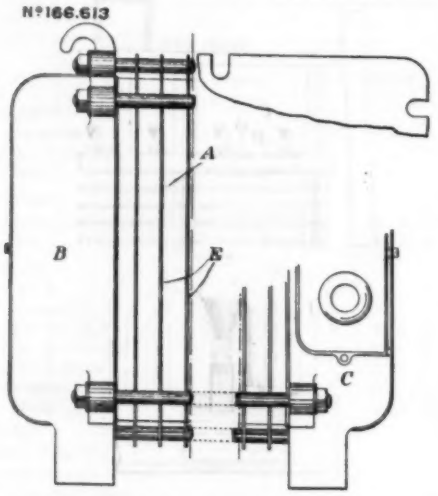
that it can be adjusted to suit the bolt holes in the base of any motor and the latter can be moved to any required position in re-

lation to the shaft it has to drive. The bracket, it will be perceived, is capable of vertical adjustment and of being secured in any adjusted position. Slidably mounted on the bracket are two supports A, which can be moved along the bracket in either direction or towards and away from one another, or be swivelled on the bracket and secured in any position to which they have been adjusted. These supports are slotted longitudinally to receive the bolts which secure the base of the motor to them.—*July 13th*, 1921.

TRANSFORMERS.

166,613. November 4th, 1920.—IMPROVEMENTS RELATING TO ELECTRIC TRANSFORMERS, The Hackbridge Cable Company, Limited, and William Charles Kennett, both of Hackbridge, Surrey.

This specification describes an improved method of cooling the laminated core and windings of a transformer. The laminations are shown in the drawing at A, whilst B and C are rectangular vertical frames supporting the active material and clamped together by horizontal bolts. Plates E are placed

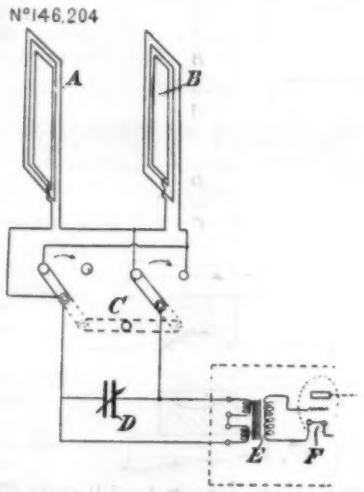


between the laminations at suitable distances, and these plates assist in dissipating the heat. The reduction of temperature due to the rapid transference of heat by these means enables the output of a transformer of given dimensions to be substantially increased.—*January 28th*, 1921.

WIRELESS TELEGRAPHY.

146,204. July 28th, 1921.—IMPROVEMENTS IN AND RELATING TO ELECTRO-MAGNETIC WAVE-RECEIVING AND TRANSMITTING ARRANGEMENTS, Société Française Radio Electrique, of 79, Boulevard Haussmann, Paris, France.

In order to obtain a resonance effect which is appreciable in reception, separate groups of coil turns are so arranged that they may be connected in series or in parallel with a view to adapting the aerial to waves of different lengths. In the case of

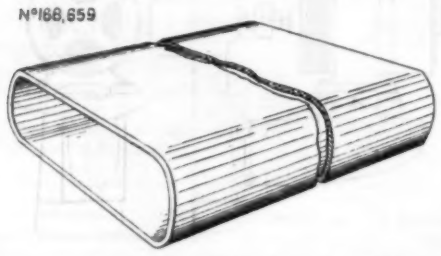


the arrangement illustrated, two coils A and B are coupled in series or in parallel by means of the switch C. Resonance is obtained in the circuit by means of the condenser D. A similar arrangement could be utilised to change at will the ratio of transformation of the transformer E, connected to the amplifier F.—*July 28th*, 1921.

MISCELLANEOUS.

166,659. April 13th, 1920.—IMPROVEMENTS IN ELECTRIC MUFFLE FURNACES, Automatic and Electric Furnaces, Limited, Lancelot William Wild and Eric Philip Barfield, all of 281, Gray's Inn-road, London.

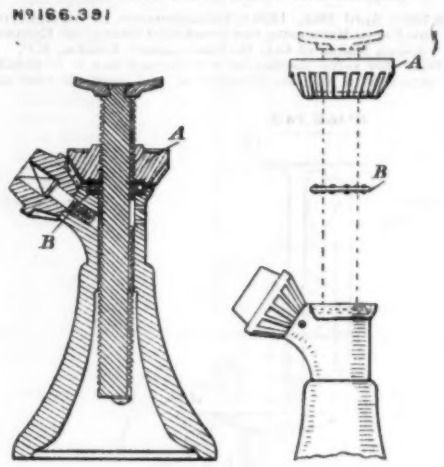
The inventors point out that electric muffle furnaces as at



present constructed are of rectangular shape or are in the form of an arch or D-shaped body. This construction, it is contended, possesses certain disadvantages in practice. It is found, for instance, that the heating wire tends to drop or sag and to draw away from the muffle during winding. The chief object of the inventors is to obviate this disadvantage, and the method adopted is to construct a furnace with the top and bottom flat and parallel with one another, whilst the ends are rounded in the manner shown in the illustration.—*July 13th*, 1921.

166,391. May 5th, 1920.—IMPROVEMENTS IN OR RELATING TO LIFTING JACKS, Arthur John Neale, of Each-way, Rubery, near Birmingham, and Walter James, of Seechem Lodge, Alvechurch, Worcestershire.

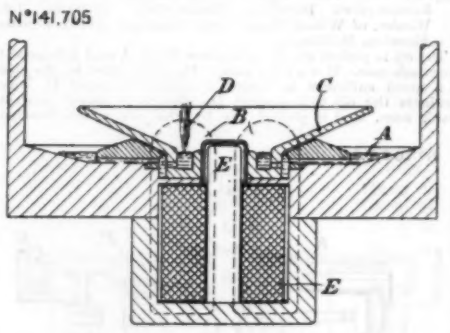
This invention relates to a screw jack in which the gear wheel or member A engaging the screwed stem of the jack is supported



on the pedestal by means of ball bearings B. It is claimed that a jack constructed on these lines will lift heavy loads with exceptional ease.—*July 21st*, 1921.

141,705. March 4th, 1915.—IMPROVEMENTS IN AND RELATING TO METAL VAPOUR ELECTRIC APPARATUS, Siemens Schuckertwerke Gesellschaft mit Beschrankter Haftung, of Siemensstadt, near Berlin.

At the bottom of the rectifier vessel is the mercury cathode A, which communicates with the annular groove B, also filled with mercury, but separated by means of the cathode plate C. The arc, which is indicated at D, moves in the field of the electro-magnet E. The arc is located in a field radiating approximately

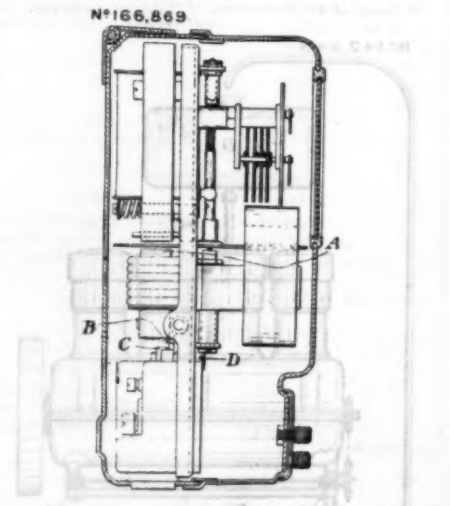


uniformly from the pole E, and the inventors explain that the arc will rotate continuously in a circle. The object of the invention is to eliminate the usual violent and disturbing arc movements which have a bad effect upon the working of this class of apparatus.—*July 12th*, 1921.

TESTING AND MEASURING INSTRUMENTS.

166,869. January 17th, 1920.—IMPROVEMENTS RELATING TO ALTERNATING-CURRENT ELECTRICITY METERS, Sebastian Ziani de Ferranti, George Wall and Ferranti, Limited, all of Hollinwood.

The object of the inventors is to provide an improved adjusting device for alternating-current instruments. A series magnet A is mounted upon a hinged piece B for the purpose of adjusting the full load speed. The heel of the hinged piece is provided with

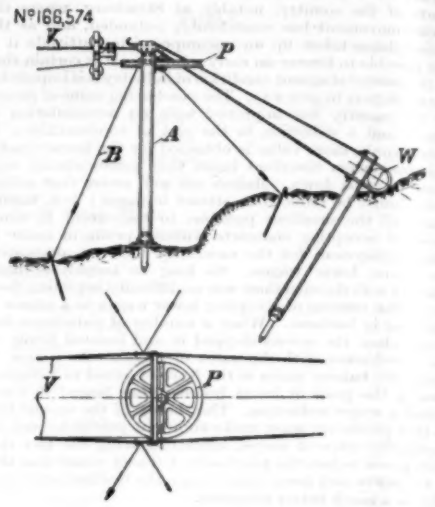


a nut C, into which a screw D is fitted so as to enable the hinged piece to be rocked by the rotation of the screw. The act of turning the screw D is thus to move the series electro-magnet further from or nearer to the shunt electro-magnet and thereby increase or decrease the rotor speed.—*July 18th*, 1921.

CRANES AND CONVEYORS.

166,574. August 6th, 1918.—AN IMPROVED TRANSPORTABLE ROPEWAY CONVEYOR, Luigi Bellani, of 19, Via Fatebenefratelli, Milan.

The terminal supporting frame for the ropeway is shown at A, and carries the return pulley P. Plugs driven into the ground keep the frame rigid. Stays B are also provided. V indicates



the return cables, which are secured by grips to the upper part of the frame A. W is a drum upon which the cables are wound in order to put them in tension, the free ends of the cable being returned and secured to the frame.—*July 11th*, 1921.

Forthcoming Engagements.

MONDAY TO SATURDAY, SEPTEMBER 5TH TO 10TH.

IRON AND STEEL INSTITUTE.—Autumn meeting in France.

TUESDAY, SEPTEMBER 6TH.

ROYAL METEOROLOGICAL SOCIETY.—Edinburgh meeting. Excursion to Eskdalemuir. An excursion by motor coach is being arranged to visit Eskdalemuir Observatory, starting from Edinburgh at 9 a.m., provided a sufficient number of Fellows notify their intention of joining in the excursion. The return journey will commence at 4 p.m.

WEDNESDAY, SEPTEMBER 7TH.

ROYAL METEOROLOGICAL SOCIETY.—Edinburgh meeting. Natural Philosophy Department of the University, Drummond-street, Edinburgh. The following papers will be read:—(1) "The Functions of a Scientific Society with Special Reference to Meteorology," by the president, Mr. R. H. Hooker; (2) "Meteorology in Medicine," by Dr. Angus Macdonald; (3) "Some Notes on Meteorology in War Time," by Mr. C. J. P. Cave; (4) "The Diurnal Variation of Pressure at Eskdalemuir, 1911-20," by Dr. A. Crichton Mitchell; (5) "The Natural Tendency Towards Symmetry of Motion and its Application as a Principle in Meteorology," by Dr. S. Fujiwhara. 2.30 p.m.

WEDNESDAY TO WEDNESDAY, SEPTEMBER 7TH TO 14TH.

BRITISH ASSOCIATION.—Annual meeting in Edinburgh. For programme see page 154.

WEDNESDAY, SEPTEMBER 7TH, TO WEDNESDAY, SEPTEMBER 28TH.

THE SHIPPING, ENGINEERING AND MACHINERY EXHIBITION.—Olympia.

THURSDAY, SEPTEMBER 8TH.

ROYAL METEOROLOGICAL SOCIETY.—Edinburgh meeting. Meteorological luncheon. A luncheon open to members of the British Association interested in meteorology and to Fellows of the Society is being arranged for Thursday, September 8th, at 1 p.m. Fellows wishing to be present should give in their names to the assistant secretary not later than at the ordinary meeting on September 7th.

FRIDAY, SEPTEMBER 9TH.

THE INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON).—By invitation of Mr. Geo. Hughes, C.B.E., chief mechanical engineer, Lancashire and Yorkshire Railway, the members of this Institution will visit the Clifton Power-house, at Clifton Junction. Special train leaving No. 1 platform, Manchester (Victoria) Station, at 2 p.m. prompt.

MONDAY, SEPTEMBER 12TH.

THE INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON) LEEDS CENTRE.—Visit to the locomotive works of Sir W. G. Armstrong, Whitworth and Co., Newcastle. Meet at the main entrance of the locomotive works at 2 p.m.

WEDNESDAY, THURSDAY, AND FRIDAY, SEPTEMBER 14TH, 15TH, AND 16TH.

INSTITUTION OF MINING ENGINEERS.—Town Hall, Stoke-on-Trent. For programme see page 239. 11 a.m.

WEDNESDAY, THURSDAY AND FRIDAY, SEPTEMBER 21ST, 22ND, AND 23RD.

THE INSTITUTE OF METALS.—Autumn meeting in Birmingham. For programme see page 151.

SATURDAY, OCTOBER 8TH.

ASSOCIATION OF ENGINEERS-IN-CHARGE.—Holborn Restaurant, London. Twenty-first annual dinner. 6 p.m.

CATALOGUES FOR THE MALAY STATES.—The British Adviser to the Government of Kedah, Malay States, is desirous of receiving in connection with projected public undertakings in Kedah, trade catalogues of (1) water supply machinery, pipes, meters and fittings; (2) sanitary appliances; (3) belting and shafting; (4) structural steelwork; (5) machine tools; (6) stone crushers and concrete mixers; (7) building materials and fittings; and (8) lifting and hauling appliances. Communications should be addressed to the British Adviser, Alor Star, Kedah, Malay States.